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

INTEGRAL
Mission Report

INT-MOC-SYS-RP-1001-OPS-OF

No. 230
Week 07

19.02.07

Routine Phase

Prepared by: M. Walker (OPS-OFO)

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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 10.02.07 until 16.02.07 (both dates inclusive) and covers the revolutions 529 and 530.

2 Summary of Activities

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

The targets of these revolutions consisted of a raster dither of IGRJ11215-5952 (RA 11:21:46.90, DEC -59:51:42.0), which was a Target of Opportunity, a hexagonal dither the Galactic Bulge Region (RA 17:45:36.00, DEC -28:56:00.0), and a raster dither of Orion OB1 (RA 05:17:00.30, DEC +01:47:17.7).

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 slews were missed during the observation period.

The fuel consumption over the period between 09/02/2007 and 15/02/2007 was 0.0829 Kg. The remaining propellant is in the order of 148.2091 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

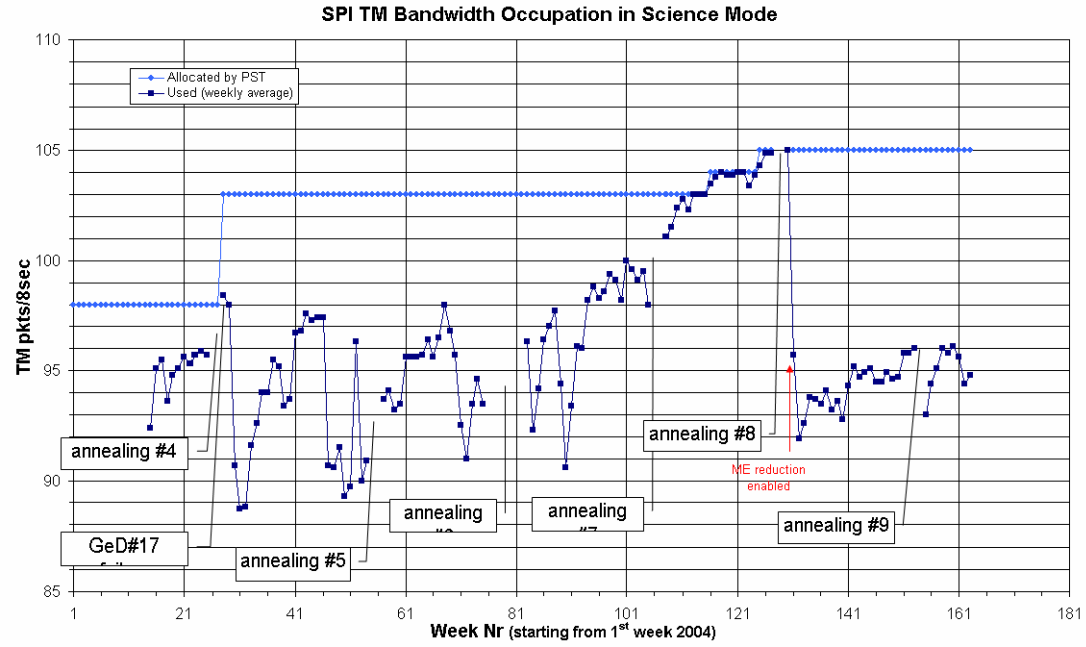
3.2.1 SPI

Following the 9th annealing, which ended on 22nd December, 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). The energy resolution of GeD#4 was recovered with this annealing. 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. The stroke of all four compressors has been set to 40 since 03.02.2007 at 13:16Z.

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 and the average telemetry occupation when the allocation was 105 packets/cycle was 94.8 packets/cycle.

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



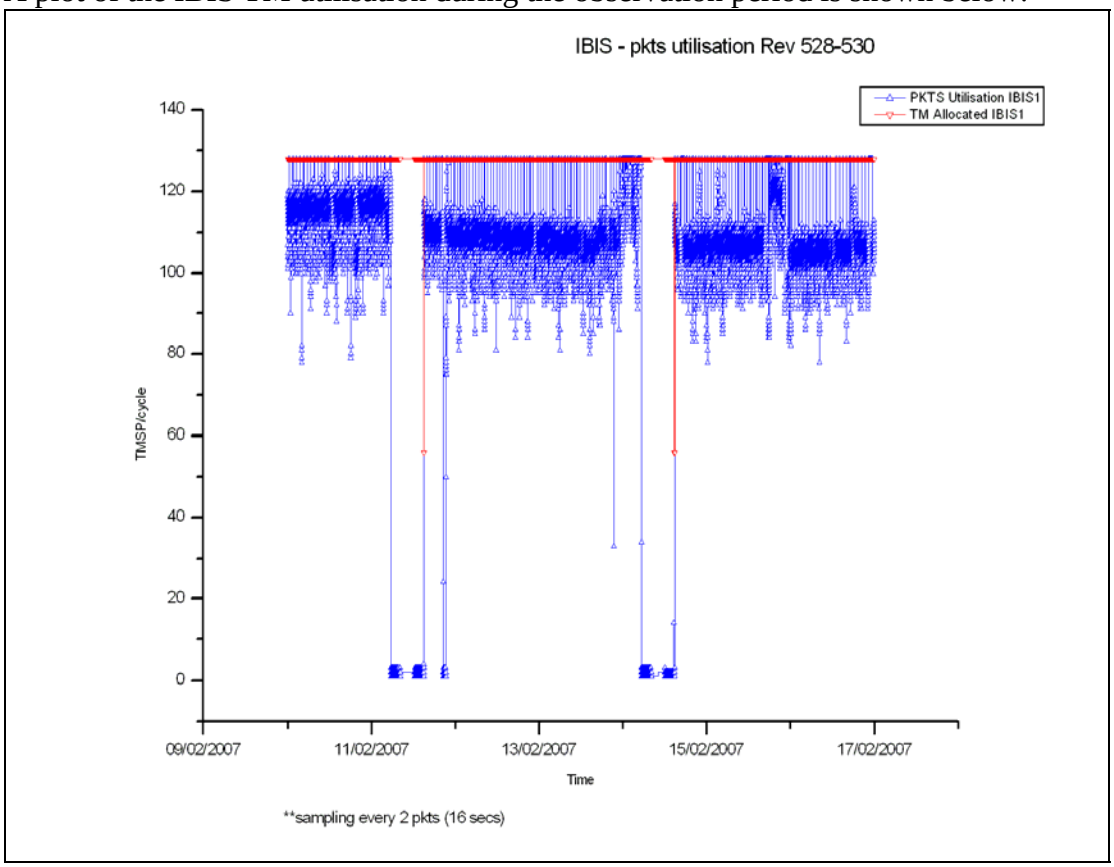
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 128 TMPS/cycle. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 110.26 TMPS/cycle, up 0.67 on last week.

A plot of the IBIS TM utilisation during the observation period 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 during science observations. JEM-X2 was dormant (DPE OFF) with no TM slots allocated.

Due to high background radiation conditions, JEM-X1 made an autonomous transition to Safe mode on 2007-02-14 at 00:34:18Z, ~4 hours before planned before radiation belt entry of revolution 529.

Further information on the JEM-X operations can be found 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/cycle.

During this reporting period, 154 of the 156 planned science pointings for OMC were executed nominally, one was interrupted and one was lost.

Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is nominal.

On 11/02/2007 at 20:35Z, the IREM SEU #44 occurred, forcing OMC and IBIS into a safe configuration. The recovery was performed following CRP_SYS_2570 and everything was back to nominal status at 23:21Z.

Solar Activity
The observation period was characterised by low solar activity.

The sun was blank this week. No threat of strong solar flare was reported.

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 pointings were lost 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, with no problems reported. The overall performance was nearly 100%.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There were, however, 3 occasions of data drops from Redu, 3 from DSS-24 and 3 from DSS-27, none of which had any impact. The overall performance was well over the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSFs are available up to revolution 539. Observations have been planned and files sent up to revolution 534. Further planning deferred to the following week.

TSF's up to revolution 533 have been received.

2. Observation status

ECS files have been received and processed up to revolution 522.

3. ISOC Science Data Archive

Work is continuing to include the results of the 3rd ISGRI catalogue. The INVITE tool was demonstrated at the Archive meeting at ISDC.

4. ISOC system

Work is ongoing on V14.4 with a planned release in early March.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 19/02/2007:

- Latest Standard Analysis completed: observation 04200730011 (Galactic disk latitude scans, Revolution 520) on 14/02/2007.

- Latest products archived: observation 04200730011 (Galactic disk latitude scans, Revolution 520) on 15/02/2007.

- Latest observation products sent to the observer: observation 04200730011 (Galactic disk latitude scans, Revolution 520) on 16/02/2007.

5 Special Events

6 Anomalies

The following problems that impacted operations were reported:

- On DoY 042 at 20:34:33z an IREM SEU (#44) caused the interruption of OMC & IBIS science data for pointing 05290007 and the loss the same for 05290008.

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

AR id	Date Created	Subject	Segment	Status
INT_SC-177	12/02/2007	AOCS: unexpected change of the FDE IAAD thresholds	Spacecraft	Open
INT-2898	15/02/2007	OBSM Checksum not Working	IMCS	Open

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 529

The observations in revolution 529 consisted entirely of a raster dither of the Target of Opportunity IGRJ11215-5952 (RA 11:21:46.90, DEC -59:51:42.0), for ~58.3hours.

Revolution 530

The observations in revolution 530 began with a raster dither of the Target of Opportunity IGRJ11215-5952 (RA 11:21:46.90, DEC -59:51:42.0), for ~25.0 hours. This was followed by a hexagonal dither of the Galactic Bulge Region (RA 17:45:36.00, DEC -28:56:00.0), which lasted ~3.5 hours. Finally a raster dither of Orion OB1 (RA 05:17:00.30, DEC +01:47:17.7), lasting ~26.3 hours was performed up to 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

```
2007-01-23T00:23:43.000Z     148.5834    F   Automatic TM processing.
2007-01-24T14:10:51.000Z     148.5718    F   Automatic TM processing.
2007-01-25T23:49:34.000Z     148.5444    F   Automatic TM processing.
2007-01-27T13:59:07.000Z     148.5361    F   Automatic TM processing.
2007-01-28T23:57:51.000Z     148.4635    F   Automatic TM processing.
2007-01-30T13:48:11.000Z     148.4569    F   Automatic TM processing.
2007-01-31T23:46:54.000Z     148.4369    F   Automatic TM processing.
2007-02-02T18:00:43.000Z     148.4023    F   Automatic TM processing.
2007-02-05T13:22:50.000Z     148.3891    F   Automatic TM processing.
2007-02-05T17:48:59.000Z     148.3516    F   Automatic TM processing.
2007-02-08T13:11:38.000Z     148.3380    F   Automatic TM processing.
2007-02-08T17:37:54.000Z     148.2920    F   Automatic TM processing.
2007-02-11T13:00:09.000Z     148.2524    F   Automatic TM processing.
2007-02-14T12:47:37.000Z     148.2310    F   Automatic TM processing.
2007-02-15T17:05:09.000Z     148.2091    F   Automatic TM processing.

This report was generated  Fri Feb 16 08:00:34 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, 10/02/2007 –16/02/2007

AOCS operations were executed from the Automatic Timeline.

During this period, 65 Open Loop Slews, 102 Closed Loop Slews and 3 Momentum Biases were executed.

No slews were missed during the observation period.

Repetitive jumps in Yccd coordinate (pitch) of guide star during PID 05300015 caused OTF toggling that affected the pointing condition for some of the payloads.

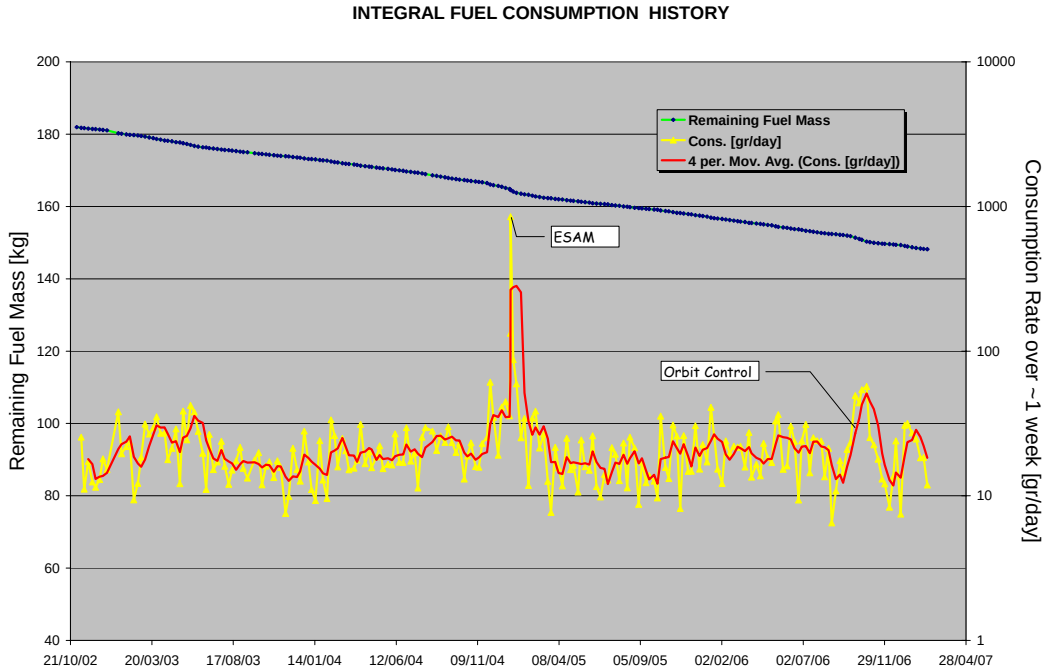
Loss of the guide star caused the OTF not to be reached during PID 05300003, 05300065.

Orbit Control

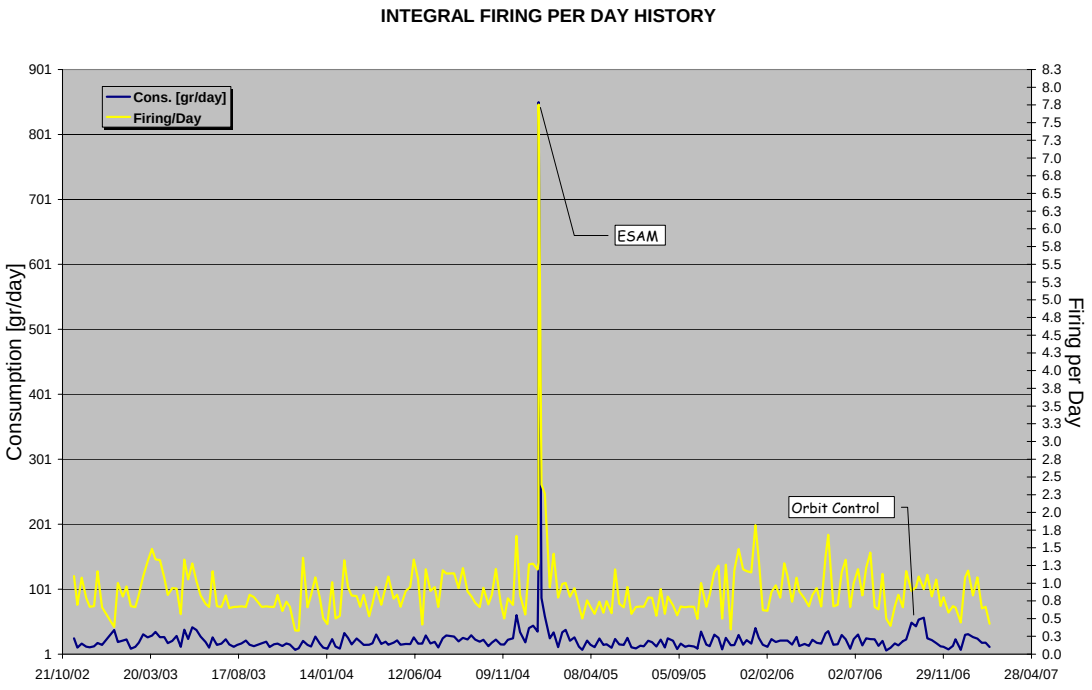
No update.

Fuel consumption

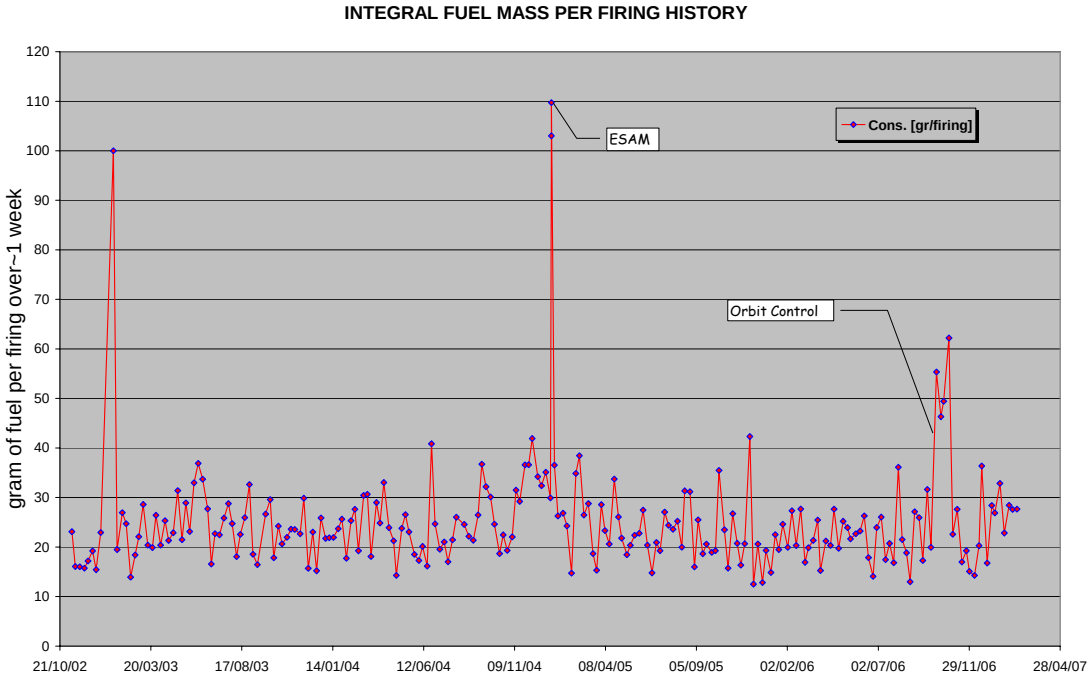
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 15/02/2007 is reported in the plot below.



The firing per day over the period between 01/11/2002 and 15/02/2007 is shown in the plot below.

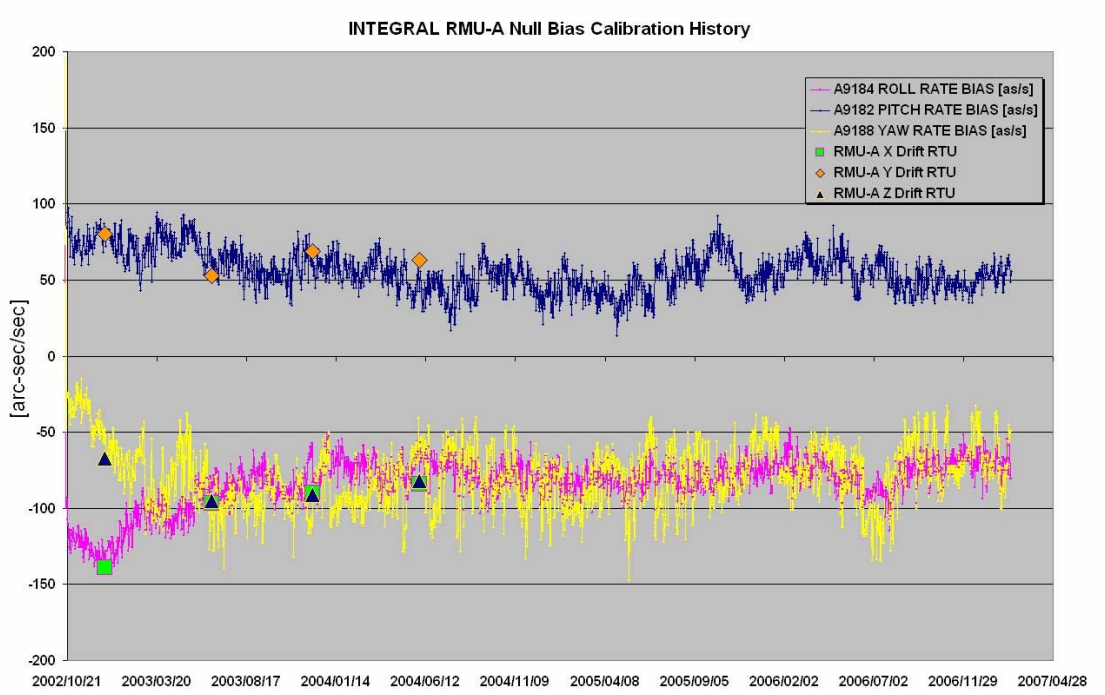


The fuel per firing over the period between 01/11/2002 and 15/02/2007 is shown in the plot below.

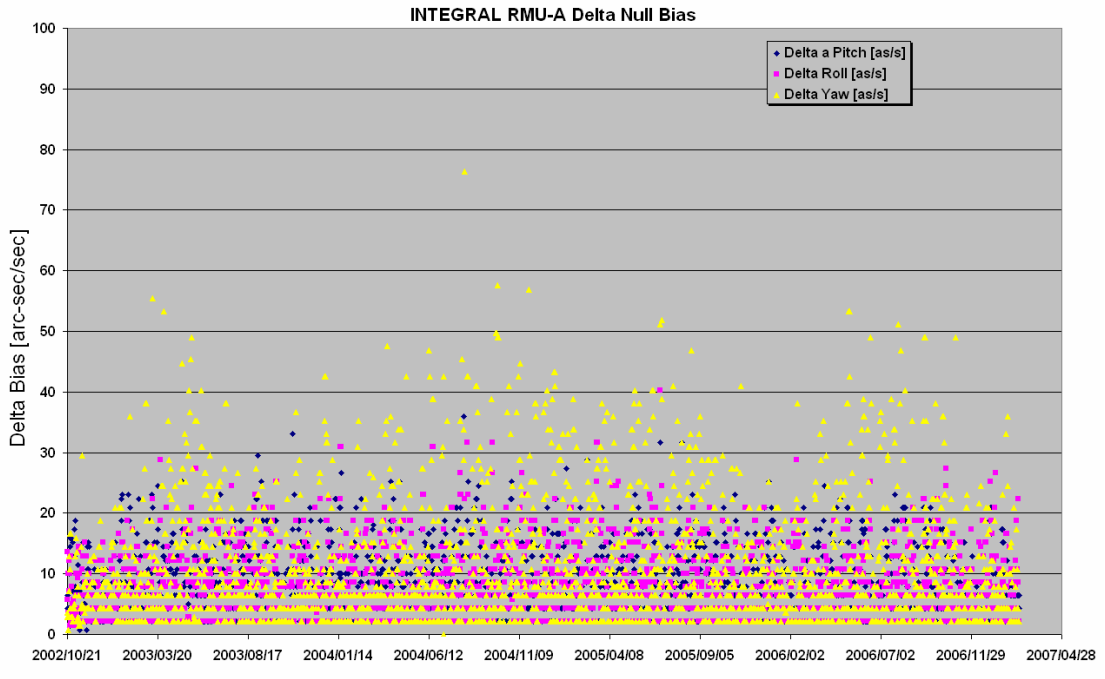


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 16/02/2007 is reported in the plot below.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 16/02/2007 is reported in the plot below



10/02/2007 (Day of Year 041, Revolution 528)

Nothing to report.

11/02/2007 (Day of Year 042, Revolution 528)

Nothing to report.

12/02/2007 (Day of Year 043, Revolution 528-529)

Nothing to report.

13/02/2007 (Day of Year 044, Revolution 529)

14/02/2007 (Day of Year 045, Revolution 529)

Loss of guide star: at 16:44:06z the guide star was lost. As automatic reaction the ACC switched ON the IMU 1 and an automatic mapping was commanded.

A manual recovery was performed and the next slew ID 05300004 was manually updated in TL.

No impact on TL reported, except the OTF was not set during PID 05300003.

15/02/2007 (Day of Year 046, Revolution 529-530)

ACC Pitch Error: at 03:11z, repetitive jumps in the guide star Yccd coordinate (pitch) were reported, during PID 05300015, which caused the pitch threshold to be exceeded and subsequent generation of several OEMs APID 640 << ACC PITCH ERROR OOL>>.

The OTF toggling, was caused by the AOCS pointing bit switching back and forth, affected the pointing condition for some of the payloads.

At the moment of the event the guide star was GSC ID 8626-296 of Mi 8.15 at STR CCD location [9494, 15284].

The reason of the problem is likely the presence of a dim companion (GSC ID 8626-884) of Mi 10.5 separated by 1 arcsec. The STR could not fix the barycentre of the system and this caused the oscillation of the Y coordinated with triggering of the associated threshold.

No impact on TL except the toggling of the OTF during PID 05300015.

16/02/2007 (Day of Year 047, Revolution 530)

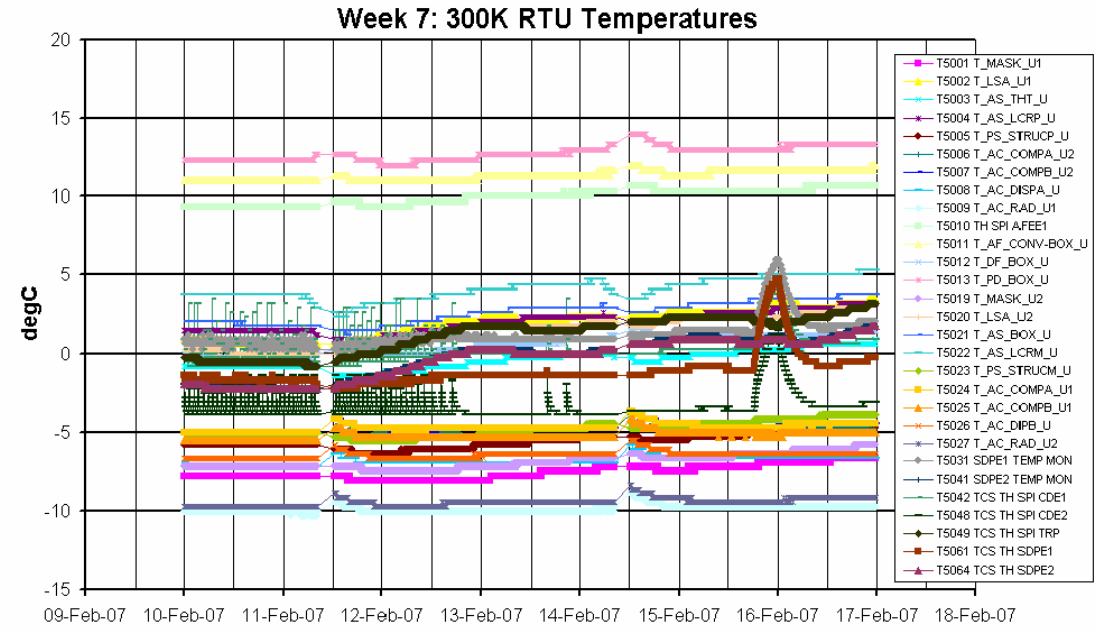
Loss of guide star: at 22:23:53z the guide star was lost. As automatic reaction the ACC switched ON the IMU 1 and an automatic mapping was commanded.

A manual recovery was performed and the next slew ID 05300066 was manually updated in TL.

No impact on TL reported, except the OTF was not set during PID 05300065.

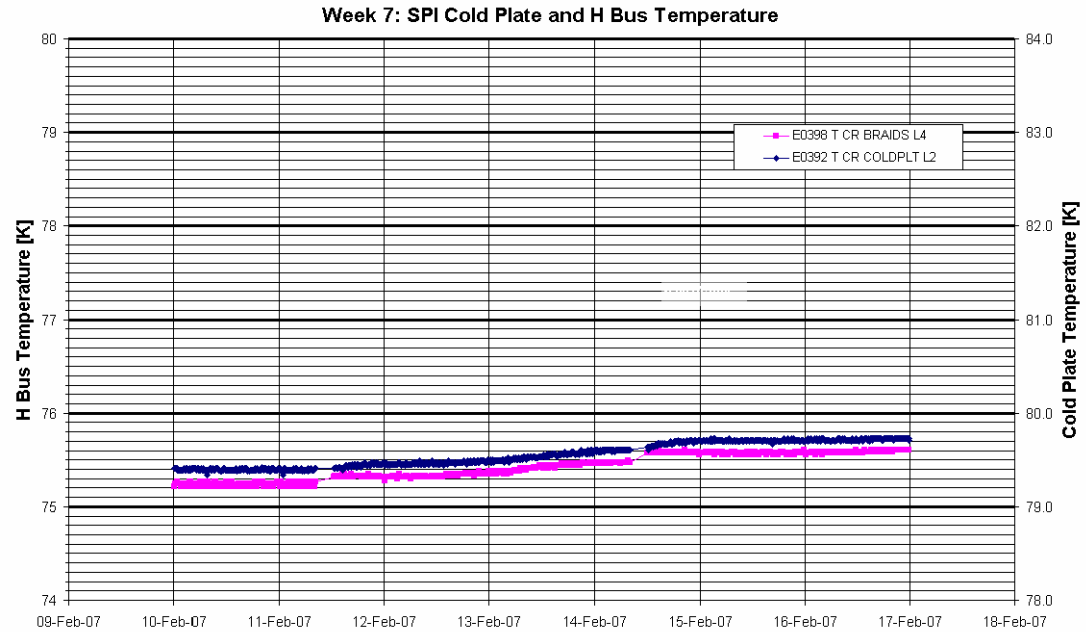
8.3.2 SPI Operations

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 to 80K +/-1K.

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

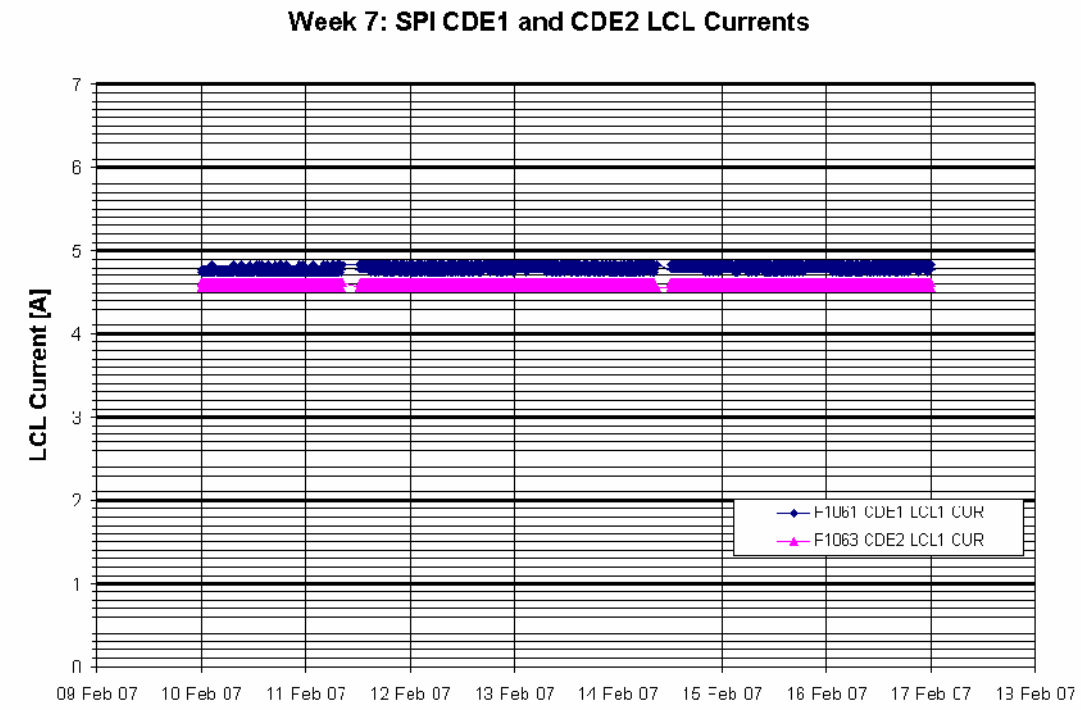


The stroke of all four compressors has been 40 since 03-02-2007 at 13:16Z.

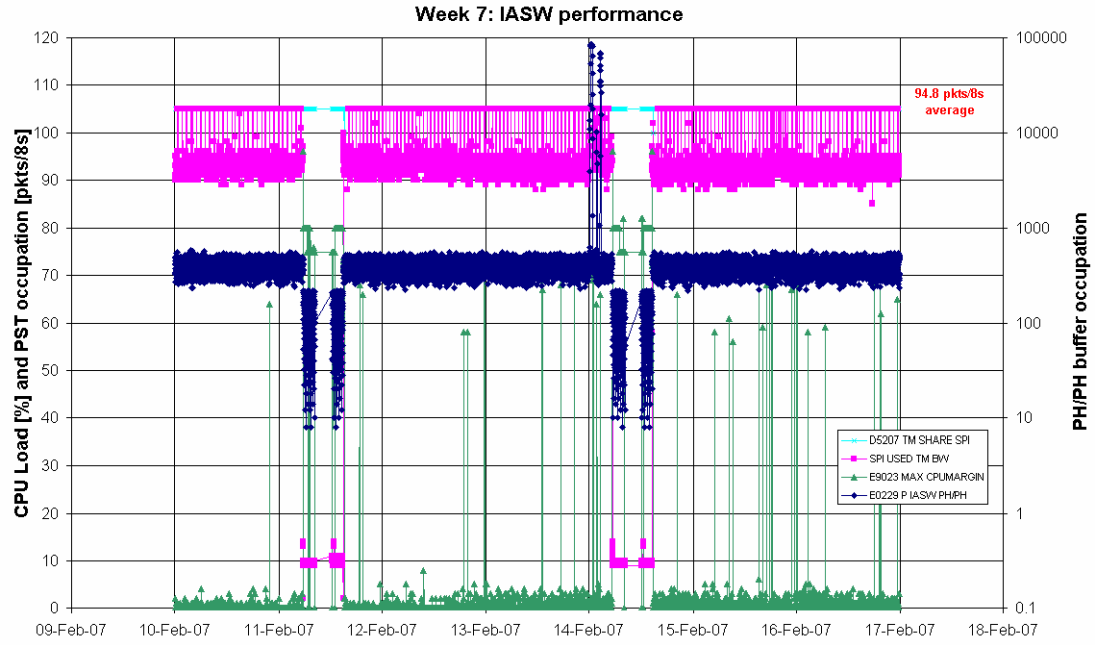
The average LCL currents of the CDEs over the week were:

- Average CDE1 LCL Current = 4.79A
- Average CDE2 LCL Current = 4.59A

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



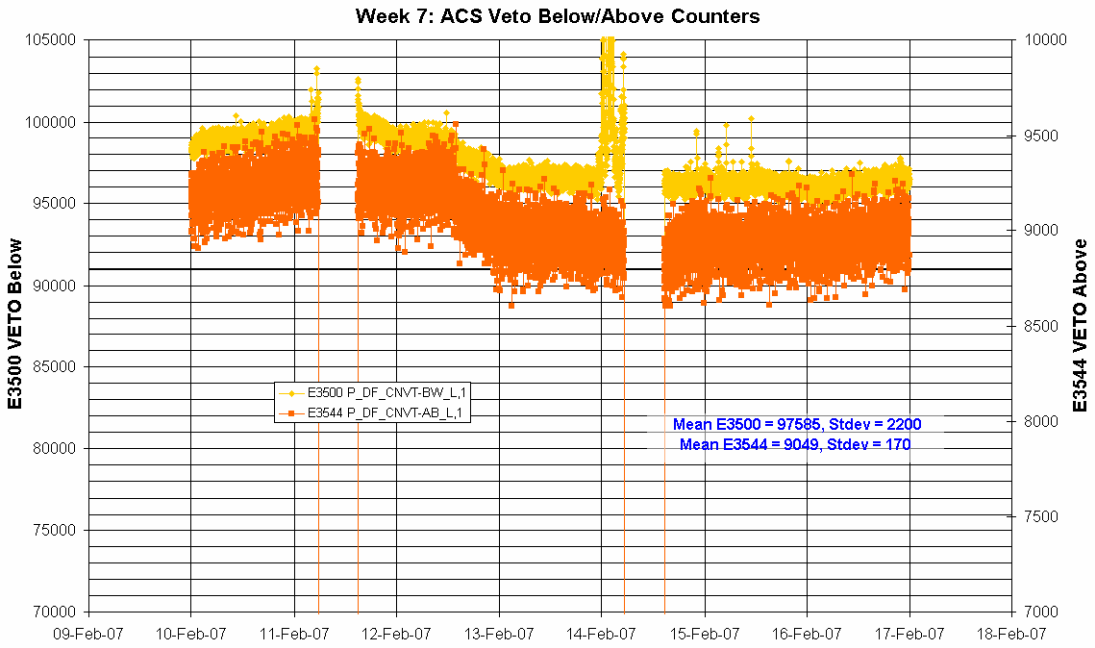
DPE & IASW: The DPE health and IASW performance is nominal. The current IASW version installed is 432. The average TM bandwidth occupation of SPI was 94.8 packets/cycle over the science window, when the TM allocation was 105 packets/cycle. The following plot shows the IASW performance in terms of TM 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). FEE #57 is also still OFF due to the anomaly on 5/8/2003 (INT_SC-61).

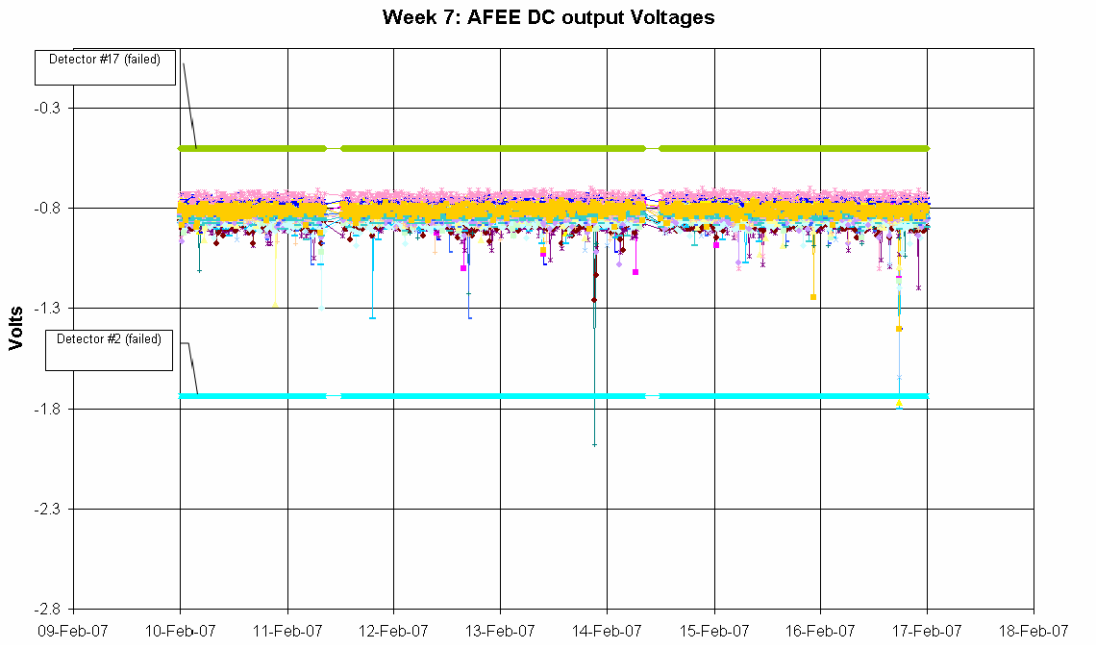
The following plot shows the ACS overall count rate evolution during the reporting period:



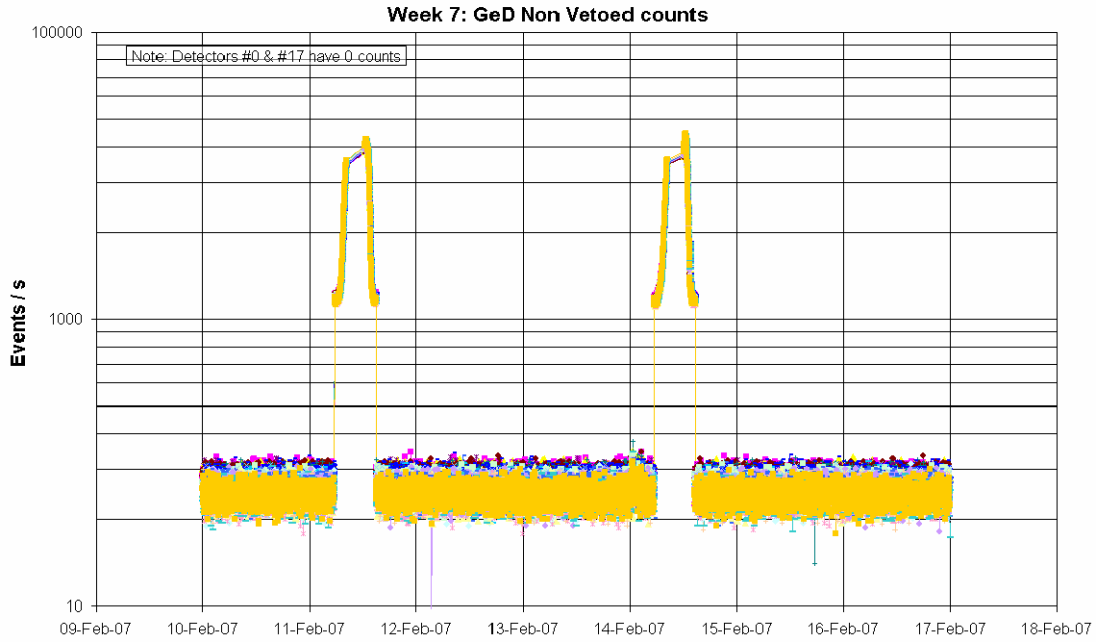
AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution. The energy resolution of GeD#4 was recovered with the last annealing.

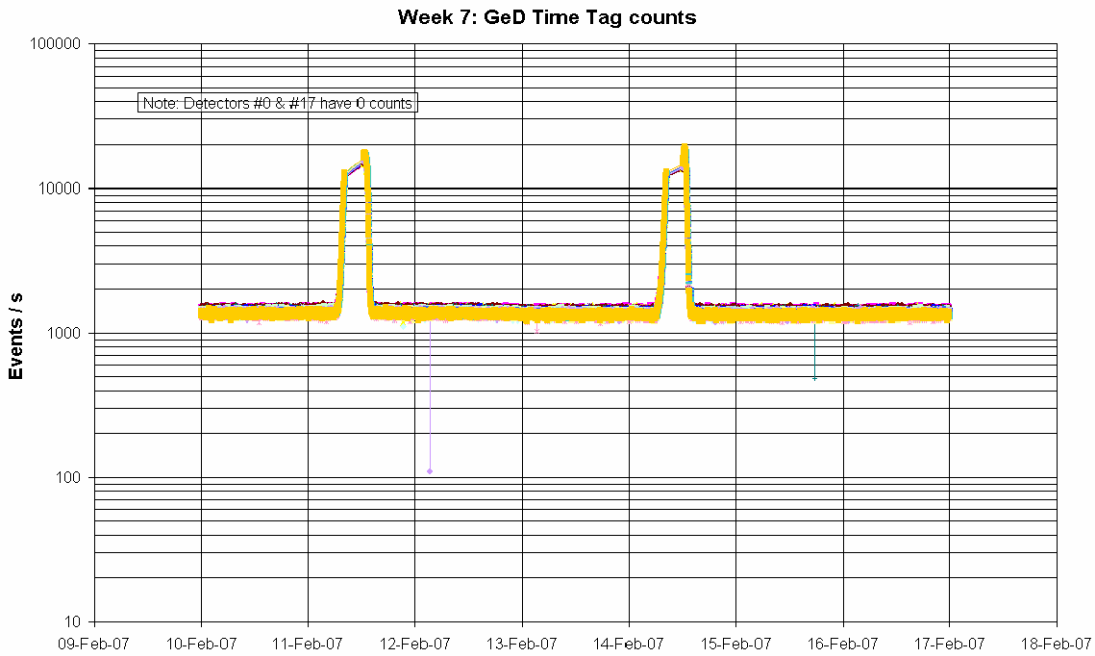
The GeD#12 HV remained at 3.5kV throughout the reporting period.

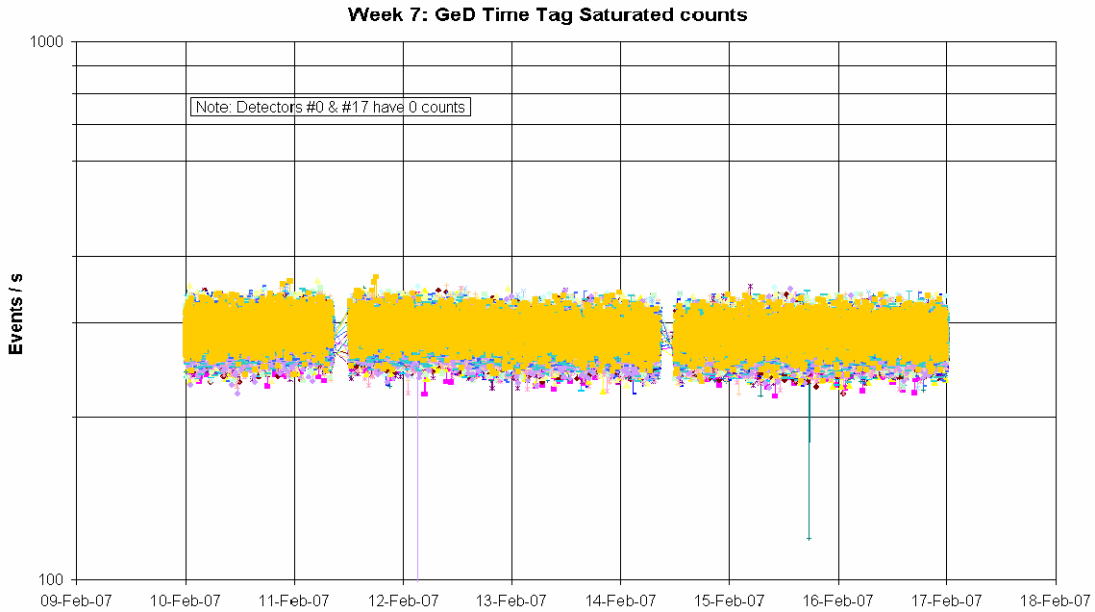
The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004.



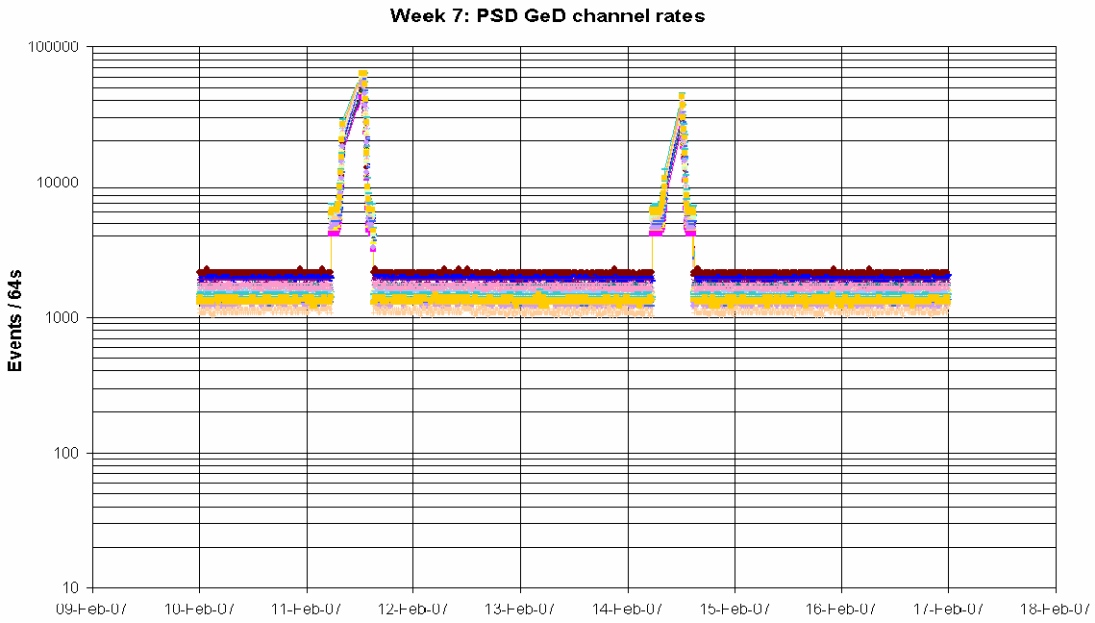
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.







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



Event Log:

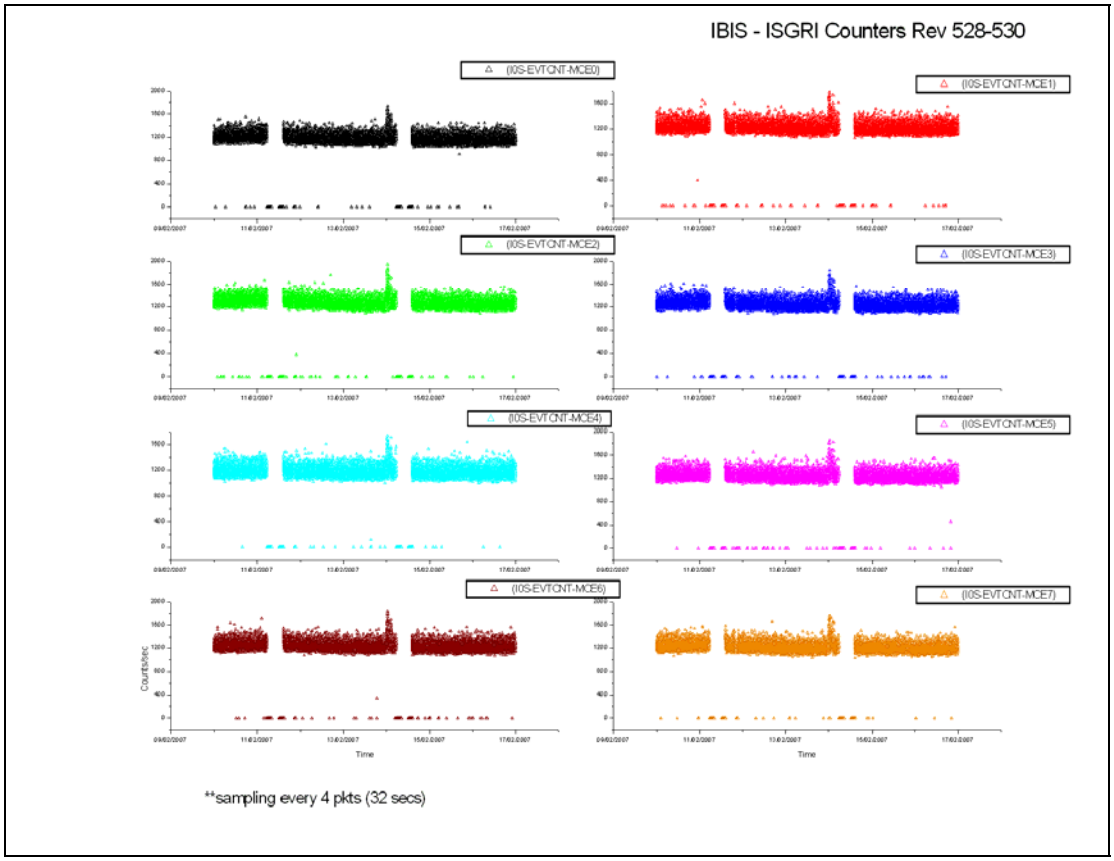
The following non-nominal events occurred on SPI during the reporting period:

- On 2007-02-14 at 00:32:44Z the TM parameter E3500 P_DF_CNVT-BW_L started toggling OOL High. This was ~5 hours before radiation belt entry of revolution 529 and no action was taken.
- TM parameter E2116 T AS PSAC L2 (Plastic Scintillator temperature) went OOL Low several times during the week. No action was taken as this is a known and recurring problem due to this thermistor being unreliable. The limit conditions for this parameter will be updated in the next IODB release.

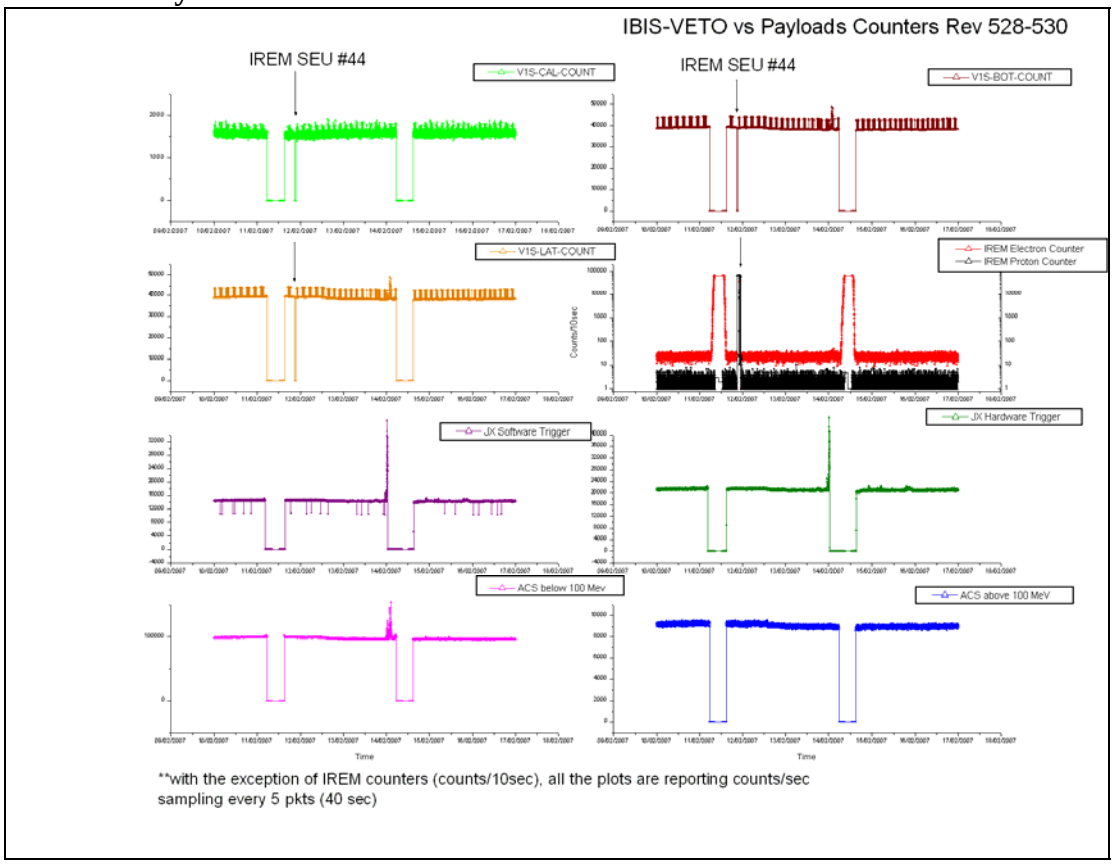
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

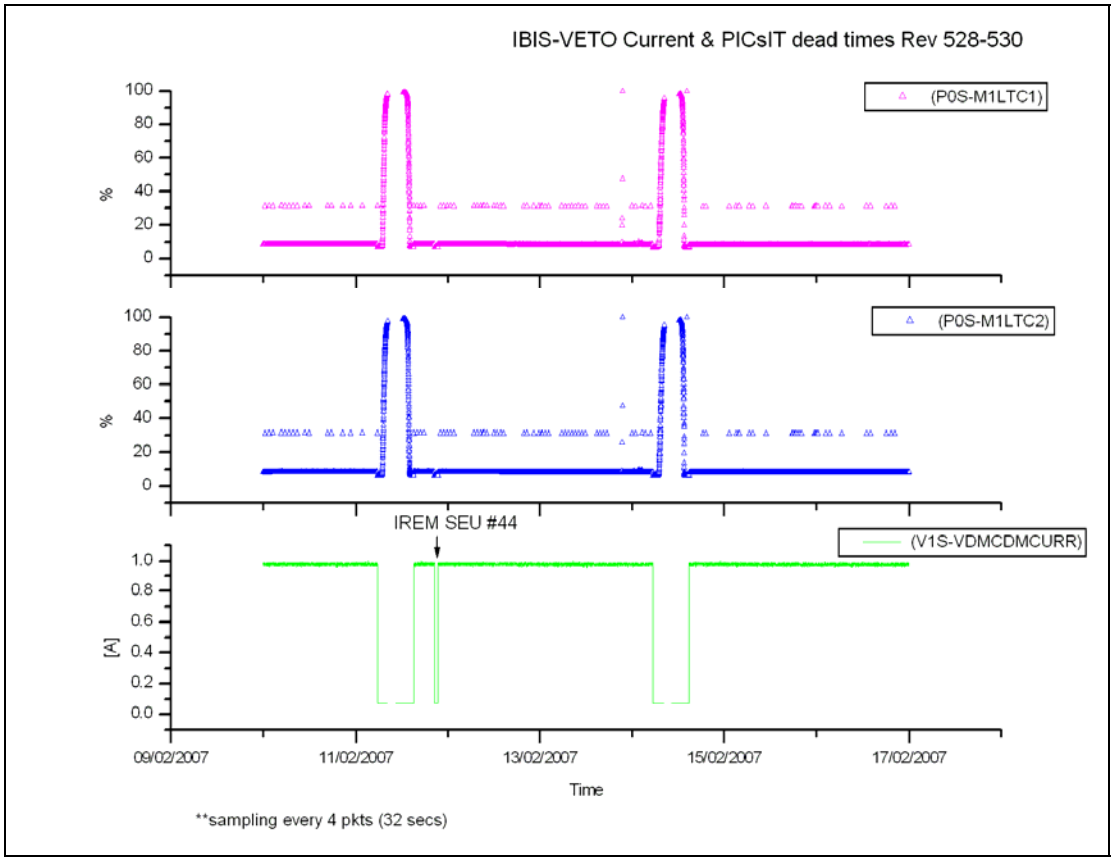


VETO vs Payloads Counters:

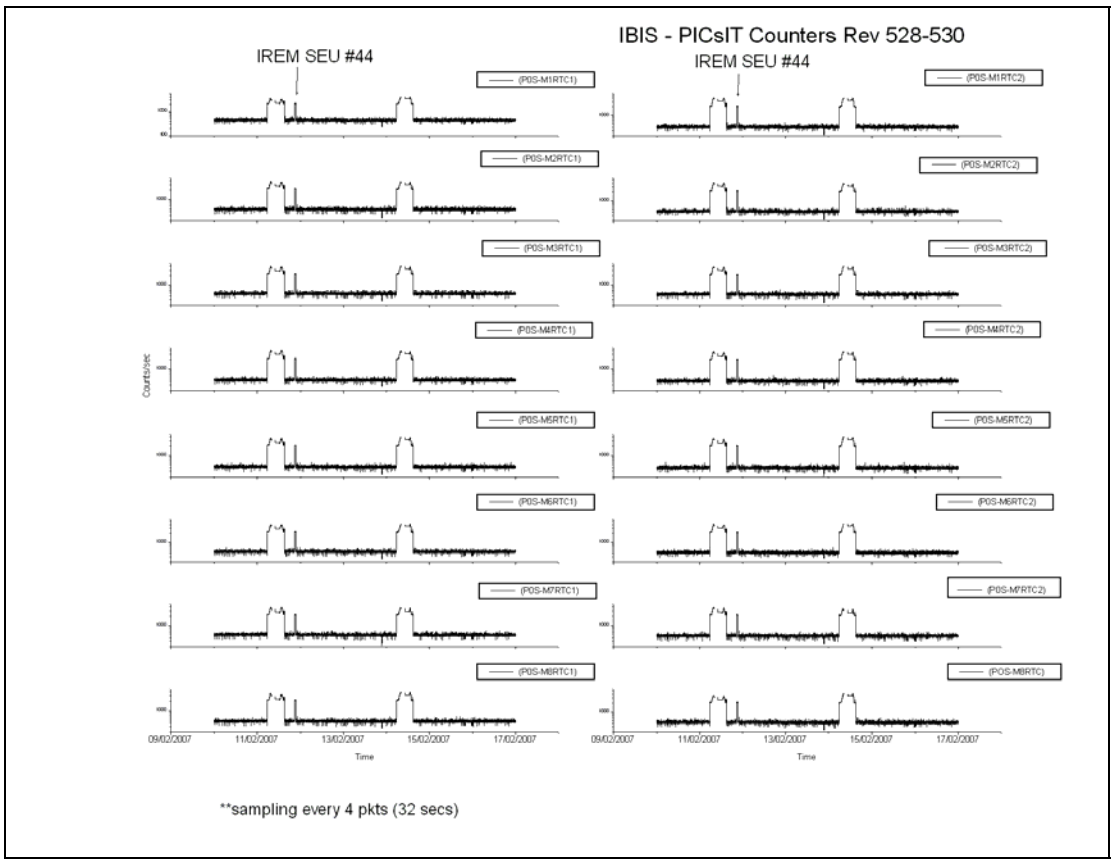


The week was characterised by low radiation.

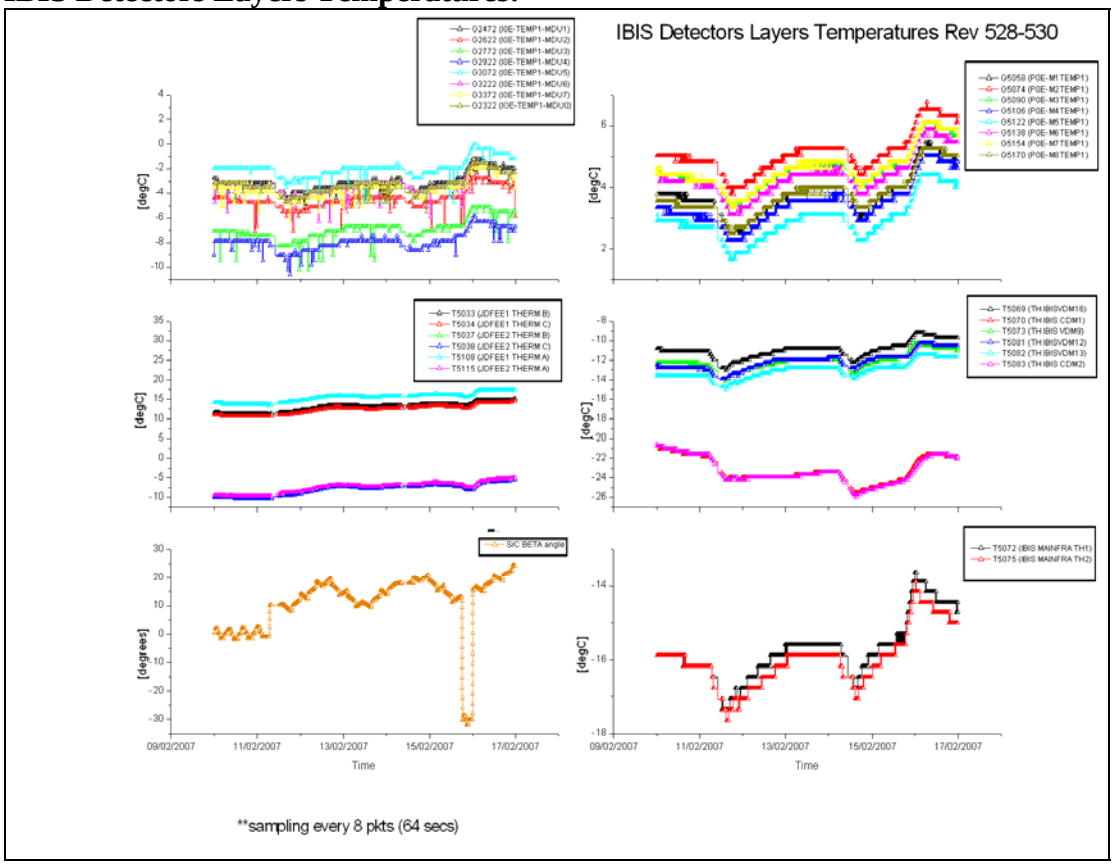
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report:

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), families G5002 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2), families G2014 (I0E-OVFWPXADD-Mi) were reported at Radiation Belts passage.

DoY 2007.042 (11/02/2007):

At 20:35Z, IBIS automatically went to Stand-By due to IREM SEU #44. The unit was recovered by the operator and was back in Scientific Standard mode at 21:30Z. The impact was the interruption of science pointings 0529007 and 0529008.

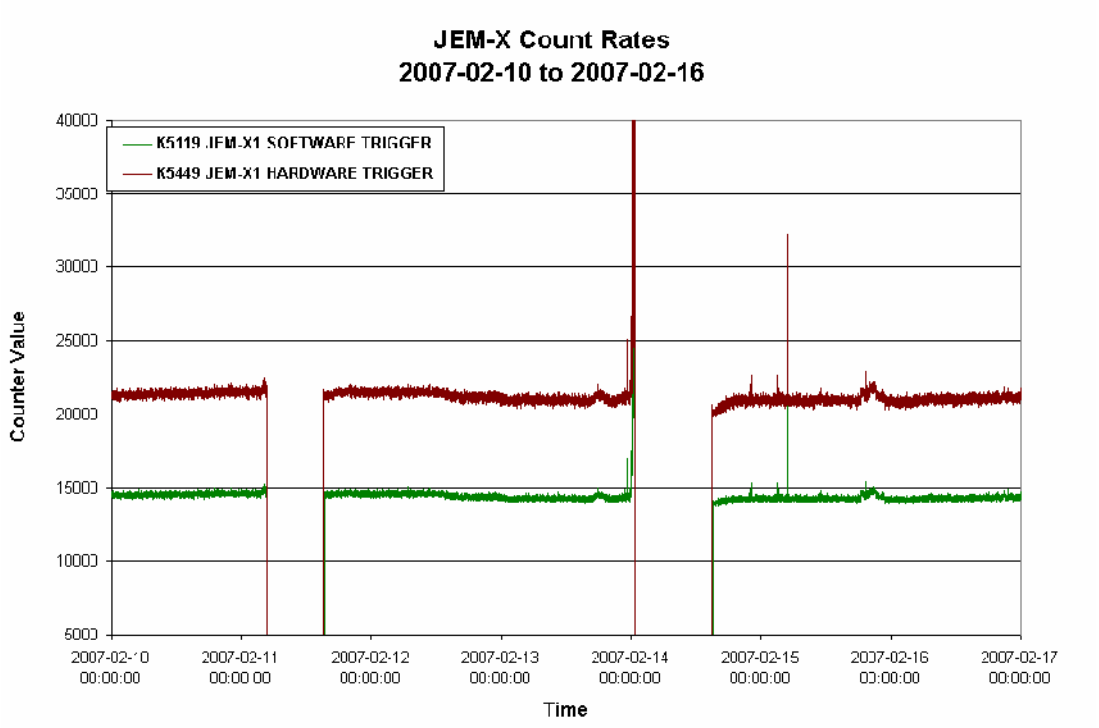
DoY 2007.044 (13/02/2007):

At 21:26Z several parameters from TM families G5068 (P0S-MiF1ERRF) and G5072 (P0S-MiF2ERRF) were reported failing Status Consistency Check.
At 21:27Z, several parameters from G5002 (P0S-Mi RTC1) and G5003 (P0S-Mi RTC2) were reported OOL LOW-LOW (value =0 cnt/s).
At 21:30Z the On Event Message APID 1280, ID 132, class 0, “IBIS1 IASW HEPI RESYNCHRONIZED” was reported.
The coincidence of these 3 events is indicating a HEPI resynchronisation and according to FDIR no action is required.

8.3.4 JEM-X Operations

JEM-X Count Rates

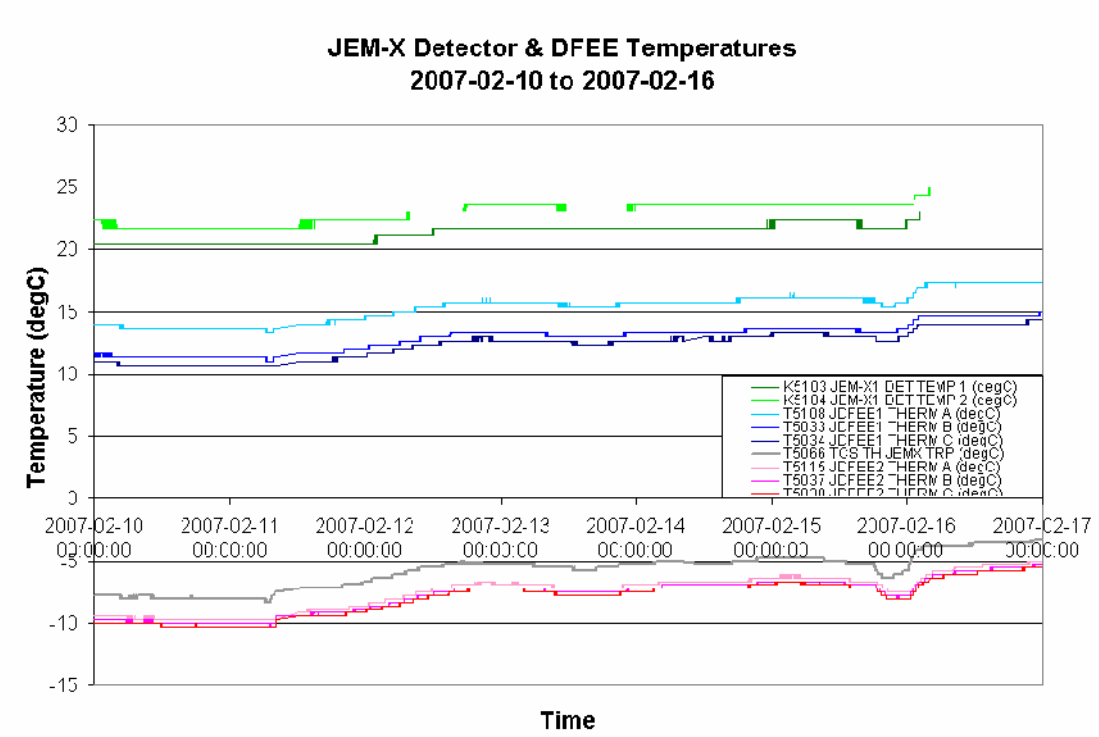
JEM-X count rates over the reporting period are displayed in the following graph[1].



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

2007-02-10 (DOY 041, Rev 528)

JEM-X1 operations executed nominally.

2007-02-11 (DOY 042, Rev 528-529)

At 20:34:39Z an IREM SW reset (see INT_SC-178) caused the IREM RMC parameters K5315-K5317 to go OOL high (value = 65535). This did not affect JEM-X1 as the JEM-X reactions to IREM are disabled.

2007-02-12 (DOY 043, Rev 529) to 2007-02-13 (DOY 044, Rev 529)

JEM-X1 operations executed nominally.

2007-02-14 (DOY 045, Rev 529-530)

Due to high background radiation conditions, at 00:14:39Z the TM parameter K5449 HARDWARE TRIGGER started toggling OOL High and at 00:18:23Z K5119 SOFTWARE TRIGGER also started to toggle OOL High. At 00:34:18Z JEM-X1 made an autonomous transition to Safe mode, triggered by the Software Ratemeter. Two occurrences of OEM 189 JEM-X1 PROB DFEE 9 (Unexpected DFEE state reported in housekeeping) were received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. At 00:40:35Z FCP_JEM1_0040 was executed, setting K5462 DFEE STATE IASW to Safe as well and OEM 254 ERROR OFF was received.

JEM-X1 operations continued nominally.

2007-02-15 (DOY 046, Rev 530) to 2007-02-16 (DOY 047, Rev 530)

JEM-X1 operations executed nominally.

8.3.5 OMC Operations

2007-02-10 (DoY 041, Rev 528)

Nothing to Report

2007-02-11 (DoY 042, Rev 529)

At 20:34:33, IREM SEU #44 caused OMC to switch to SAFE mode. A recovery was performed, and the unit returned to Stand-by at 21:37:07. The impact was the interruption after 816 from a scheduled 3000 seconds of pointing 05290007, and the loss of pointing 05290008.

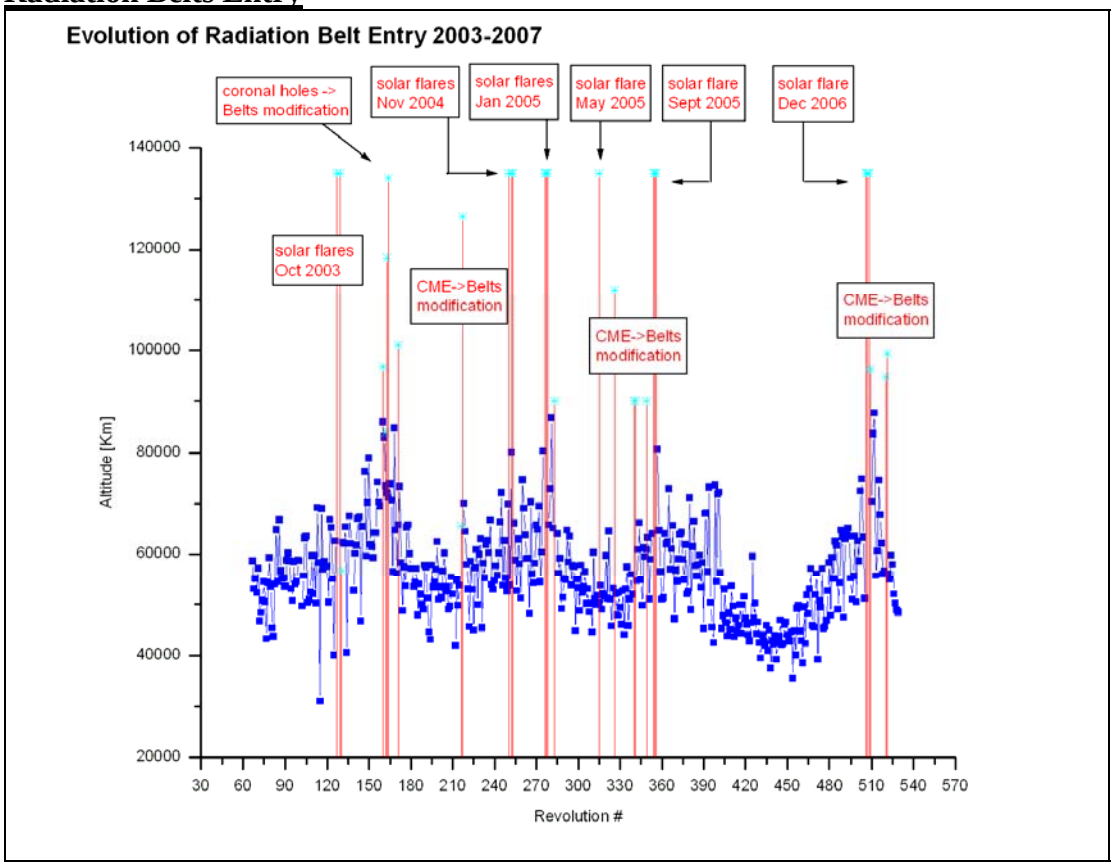
2007-02-12 (DoY 043, Rev 529) to 2007-02-16 (DoY 047, Rev 530)

Nothing to Report

On DoY 042 at 05:36:09 and DoY 045 at 05:26:02 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

DoY 2007.042 (11/02/2007):

On 2007/02/11 at 20:35Z, a local reset of the IREM CSCI S/W (SEU #44) occurred as previously the status of the unit, before the anomalies, was nominal, here is a summary:

1) The temperatures were nominal
2) The LCL current was nominal
3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits
4) The anomaly occurred at 2007.042.20.35.00Z at 85092.1km. The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit
5) The recovery of the unit started at 20:35Z using procedure CRP_SYS_2570. The first dump of the status word after the anomaly showed a value of BCC0 HEX = 48320 DEC = 1011110011000000, i.e the Checksum Failure flag shows YES. The unit was still reporting the status as if it was in Integral mode with counting ON, accumulation ON and checksum failure flag ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.

6) A dump of all the registers gave a status word BC80 HEX = 48256 DEC = 1011110010000000, ie. the unit was still reporting the status as if it was in Integral mode but the Checksum Failure flag was this time OFF and the checksum counter in the register number 3 incremented by 1 unit.
7) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 23:17Z.

The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the PIs request.
The recovery of the payload was performed with OMC re-enabled at 21:38Z and IBIS re-enabled at 21:30Z.

The cause of these S/W resets is still under investigation, but it is apparently due to the unit's memory device that is sensitive to radiation.

DoY 2007.045 (14/02/2007):

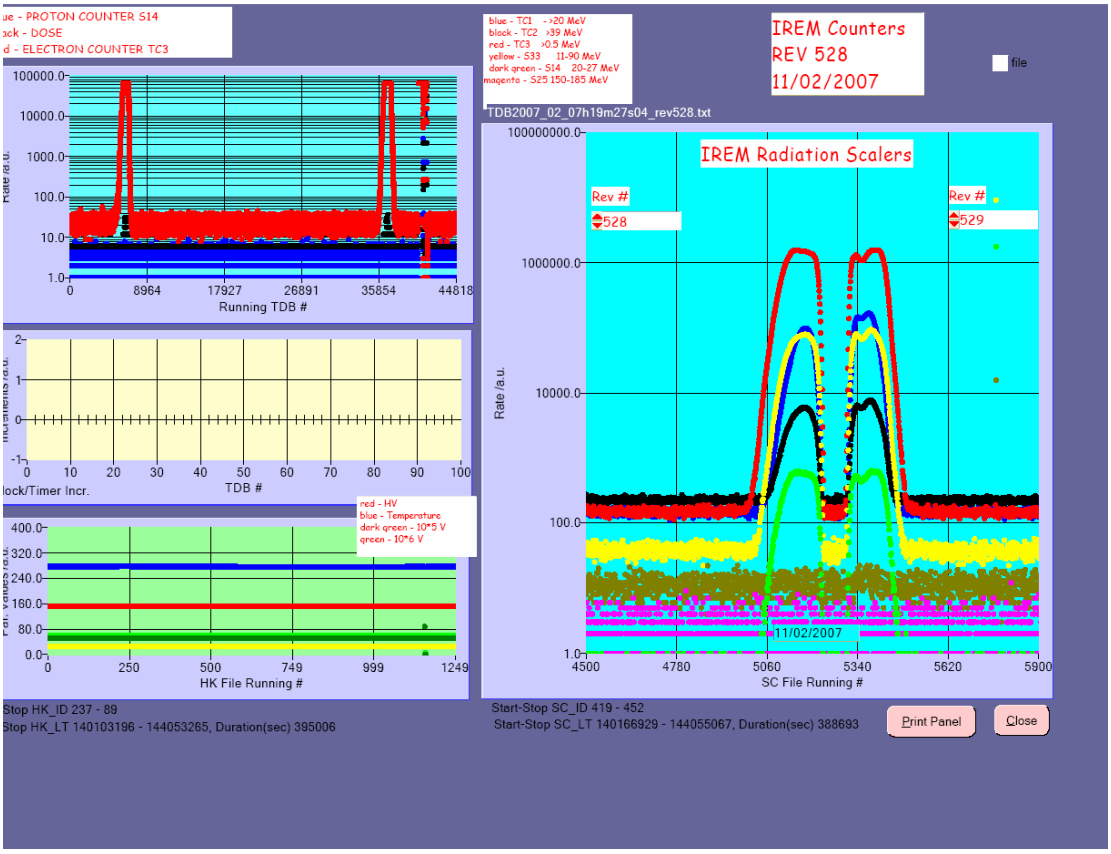
On 14/02/2007 (DoY 2007.045) at 12:41Z TC U4920 from ED UEGROF01 failed CEV due to a late update of the telemetry. The operator checked that the command was executed in display AND U0001 (TM parameter U9903 = OFF) and no further action was taken.

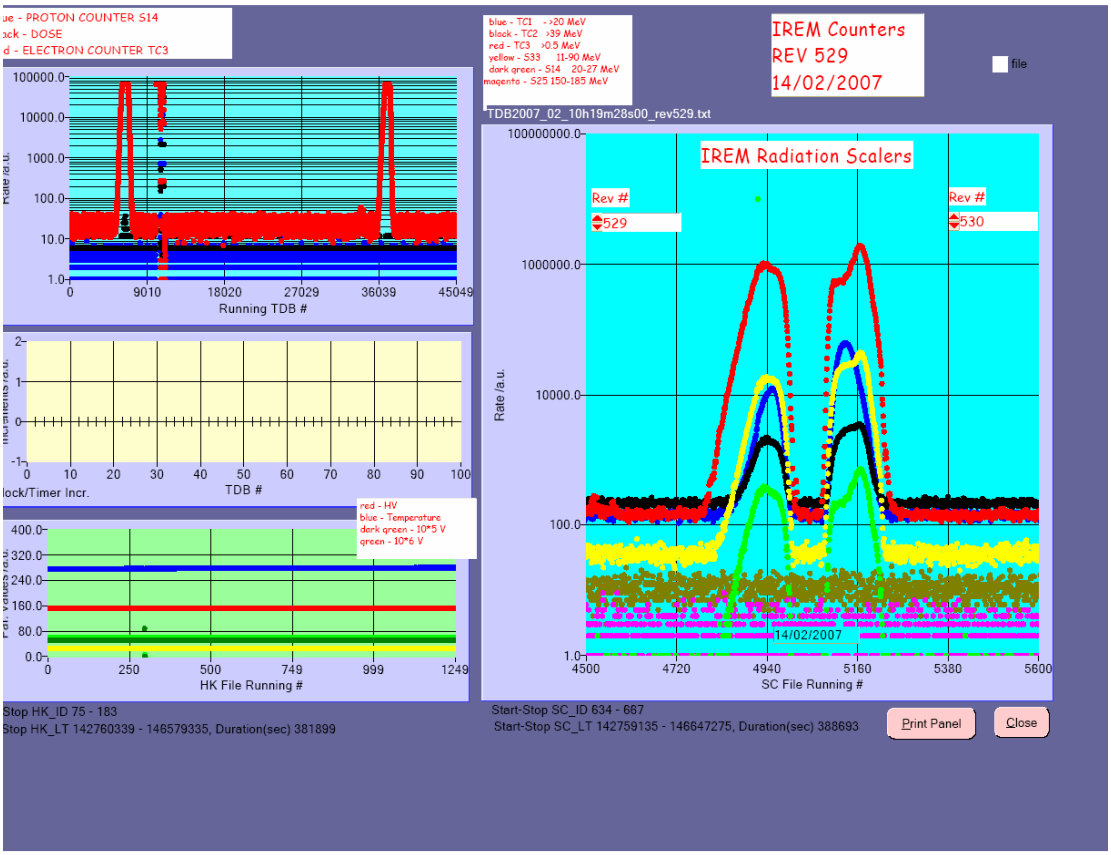
Electron Belts

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]
528	RAD_ENTR R 2007-02-11T05:36:04Z	2007-02-11 06:28:56	48880.4	2007-02-11 06:37:11	47635
529	RAD_EXIT R 2007-02-11T14:52:44Z	2007-02-11 14:23:12	<<46977.0	2007-02-11 14:27:11	41236
529	RAD_ENTR R 2007-02-14T05:26:00Z	2007-02-14 06:25:52	48418.3	2007-02-14 06:21:28	48226
530	RAD_EXIT R 2007-02-14T14:42:09Z	2007-02-14 13:51:44	>>29777.0	2007-02-14 14:21:28	42187

Reference
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)
Radiation Spike

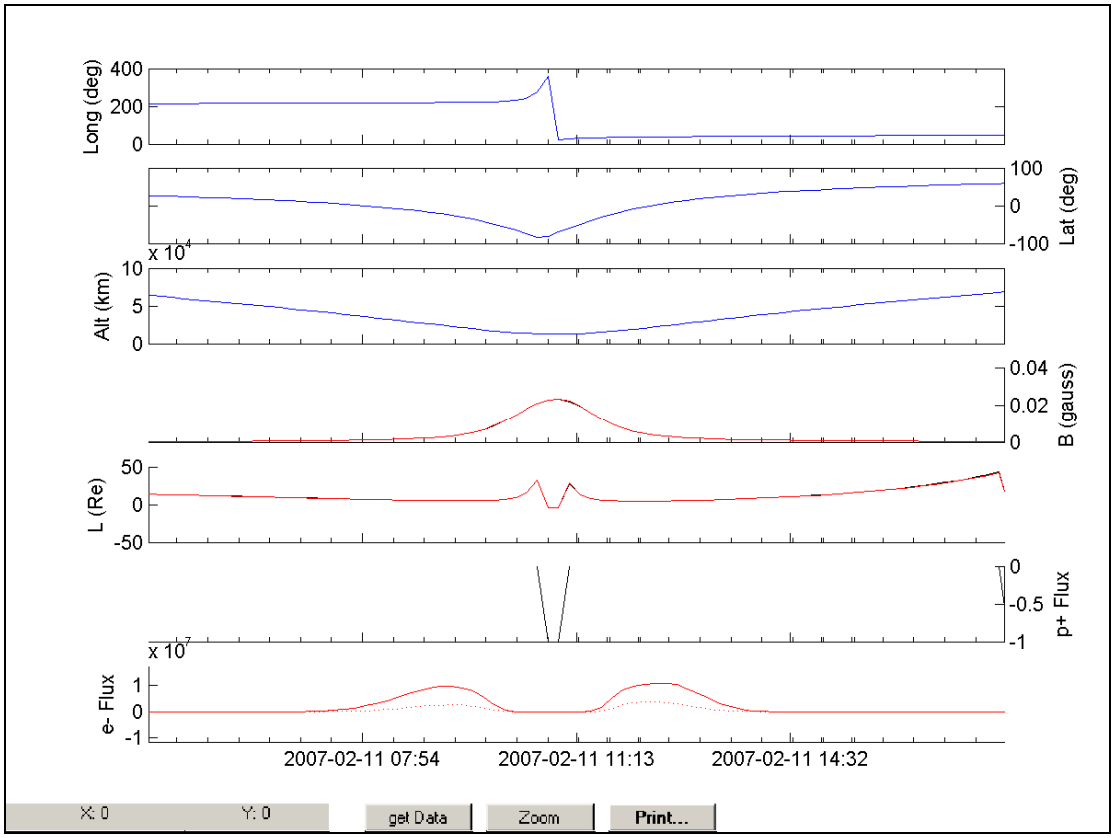
IREM radiation counters:



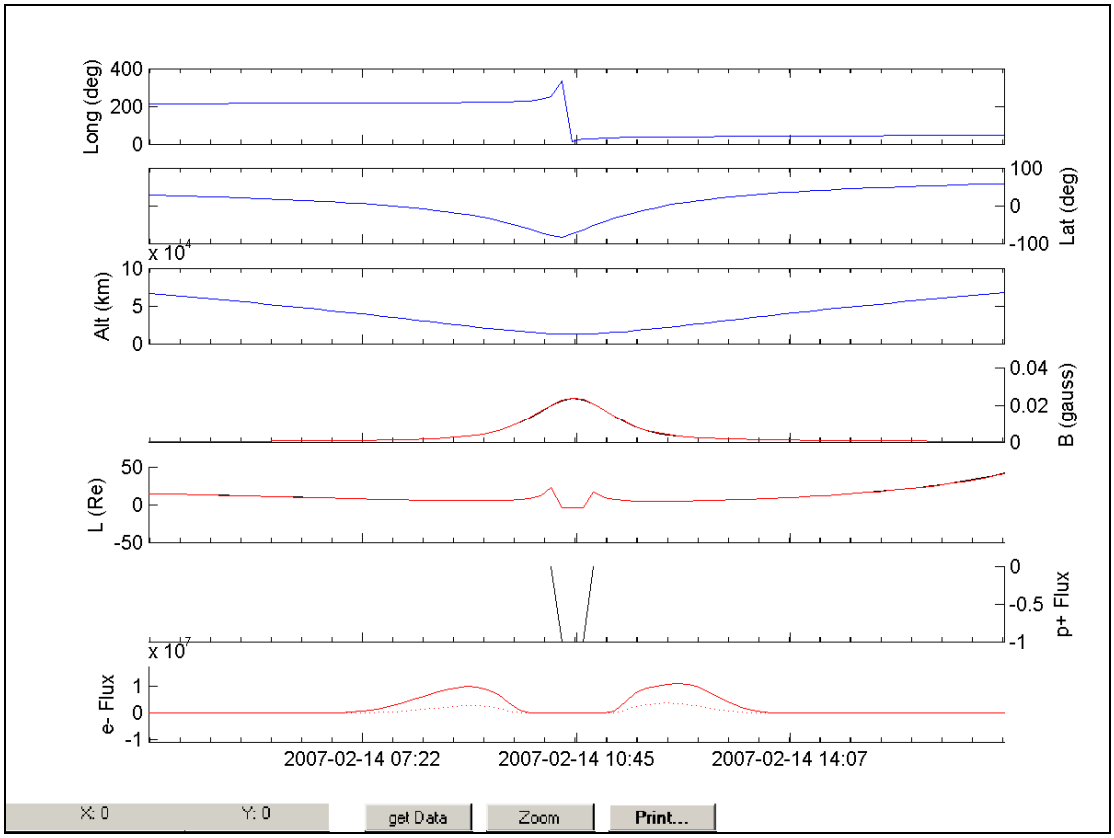


IREM Predicted Radiation Belt Passages

Rev 528



Rev 529



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

No plot is available this week. But the background was essentially low.