

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 228
Week 05
05.02.07
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 27.01.07 until 02.02.07 (both dates inclusive) and covers the revolutions 524, 525 and 526.

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 raster dithers of SN1006/Cen X-4 (RA 15:00:26.27, DEC -36:47:29.6), GX 339-4, a Target of Opportunity (RA 17:02:49.50, DEC -48:47:23.0), and the Galactic Plane Region 4 (RA 21:44:04.54, DEC +53:09:58.7).

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 26/01/2007 and 02/02/2007 was 0.1826 Kg. The remaining propellant is in the order of 148.4023 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

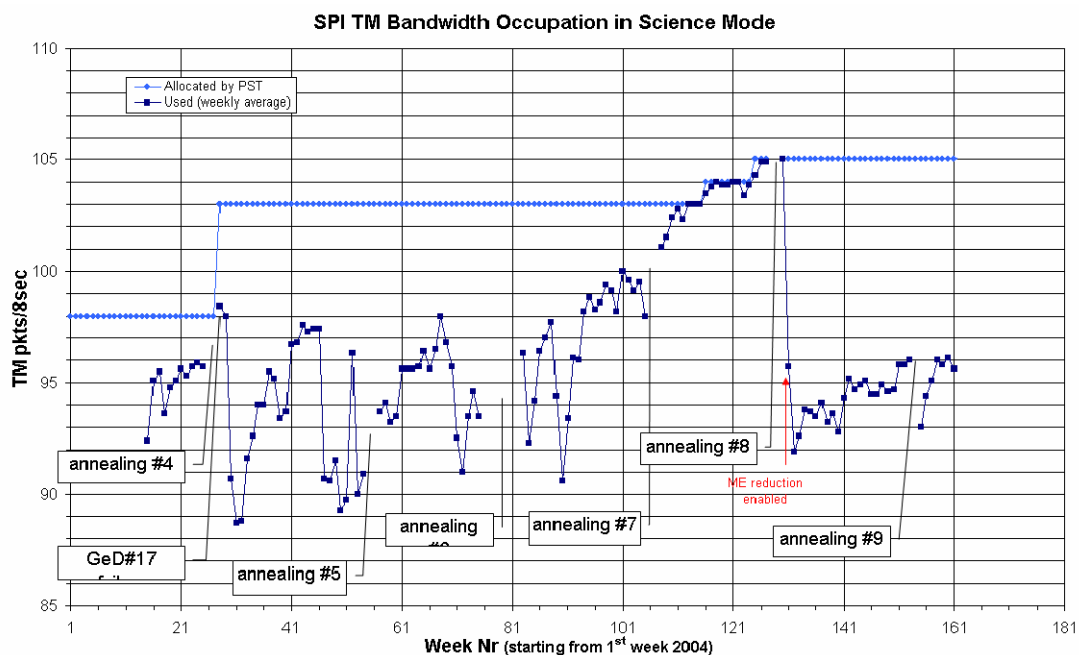
3.2.1 SPI

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 is 39 since 19.01.2007.

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 95.6 packets/cycle.

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



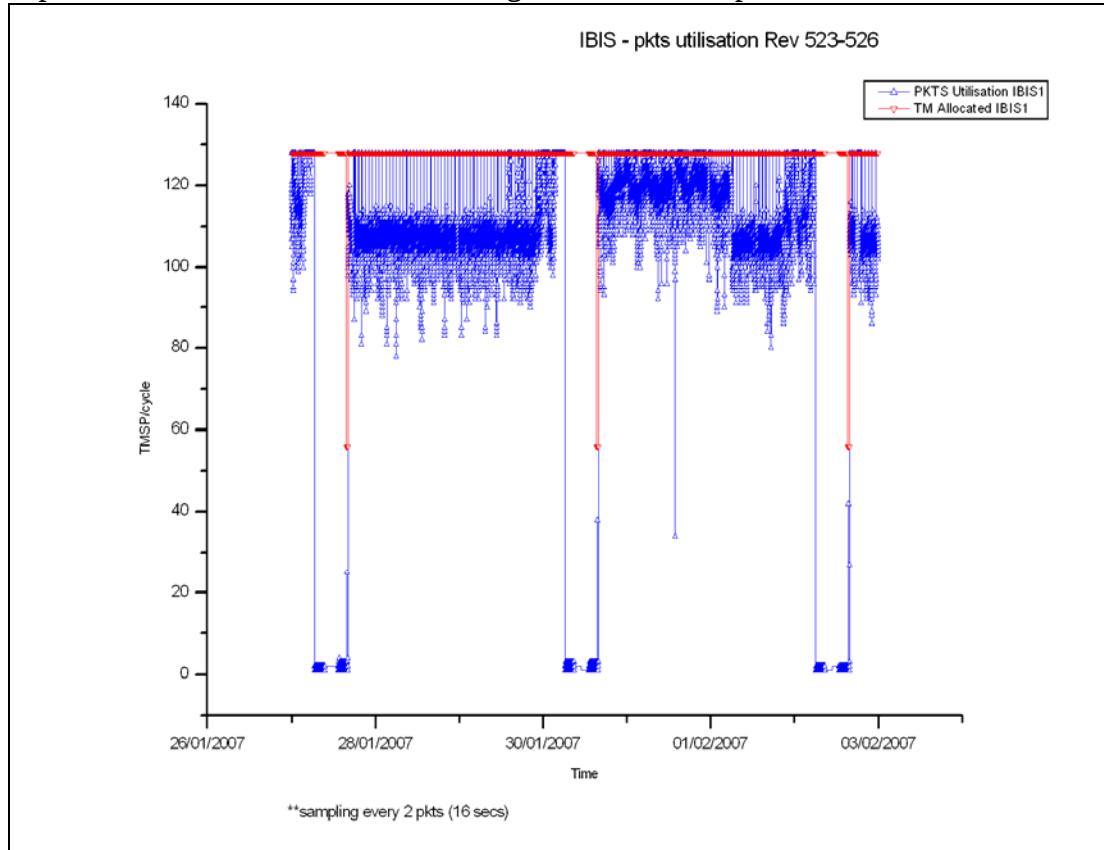
Note: Some more information concerning the SPI operations is provided in the Appendix.

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 112.79 TMPS/cycle, down 1.16 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 2007-01-30 at 04:12:42Z, ~75 minutes before planned before radiation belt entry of revolution 524.

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, all of the 149 planned science pointings for OMC were executed nominally, none were 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.

Solar Activity

The observation period was characterised by low solar activity.

Two sunspots were present on the surface of the sun this week: 940 and 941. They were both big, but neither of them posed a threat of strong 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. No slews were lost. The overall performance was nearly 100%.

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 bad frames from Redu, one hit on the line, and 2 occasions of short drops from DSS-24, none of which had any impact. The overall performance was nearly 100%.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSFs are available up to revolution 532. Observations have been planned and files sent up to revolution 532.

TSF's up to revolution 522 have been received.

2. Observation status

ECS files have been received and processed up to revolution 519 with revolution 515 missing.

3. ISOC Science Data Archive

Routine ingestion of data has restarted without problems following the move of the database to a new server.

Preparations have begun for producing observation level mosaics for ISDA V2.7 (a very long standing requirement).

4. ISOC system

The current version is still 14.2.1. Version 14.3 which will support proposal submission for AO-5 is being tested in a special effort next week.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 05/02/2007:

- Latest Standard Analysis completed: observation 04200830001 (GX 301-2, Revolution 518) on 05/02/2007.
- Latest products archived: observation 04200730001 (Galactic disk latitude scans, Revolution 514) on 05/02/2007.
- Latest observation products sent to the observer: observation 04200030001 (MCG - 05-23-016, Revolution 508) on 22/01/2007.

5 Special Events

6 Anomalies

There were no problems reported that impacted operations.

There were no new anomaly reports entered into the ARTS system this week:

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 524

The observations in revolution 524 began with a Dummy pointing, a staring observation at attitude (RA 14:40:00.00, DEC -10:00:00.0), for ~1.7hours. This was followed by a raster dither of SN1006/Cen X-4 (RA 15:00:26.27, DEC -36:47:29.6), for ~57.2 hours, which lasted until the end of the revolution.

Revolution 525

The observations in revolution 525 began with a raster dither of GX 339-4, a Target of Opportunity (RA 17:02:49.50, DEC -48:47:23.0), for ~36.1hours. This was followed by a raster dither of SN1006/Cen X-4 (RA 15:00:26.27, DEC -36:47:29.6), for ~21.0 hours, which lasted until the end of the revolution.

Revolution 526

The observations in revolution 526 began with a raster dither of the Galactic Plane Region 4 (RA 21:44:04.54, DEC +53:09:58.7), for ~2.1hours. This was followed by a raster dither of SN1006/Cen X-4 (RA 15:00:26.27, DEC -36:47:29.6), for ~55.2 hours, which lasted 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

2007-01-16T05:15:49.000Z	148.8040	F	Automatic TM processing.
2007-01-18T07:08:02.000Z	148.7579	F	Automatic TM processing.
2007-01-18T14:34:11.000Z	148.7270	F	Automatic TM processing.
2007-01-20T00:35:59.000Z	148.6979	F	Automatic TM processing.
2007-01-21T14:22:11.000Z	148.6816	F	Automatic TM processing.
2007-01-22T09:26:13.000Z	148.6488	F	Automatic TM processing.
2007-01-22T13:15:00.000Z	148.6277	F	After thruster torque calibration
2007-01-22T14:16:13.000Z	148.6052	F	Automatic TM processing.
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.

This report was generated Fri Feb 2 08:00:31 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, 27/01/2007 –02/02/2007

AOCS operations were executed from the Automatic Timeline.

During this period, 65 Open Loop Slews, 97 Closed Loop Slews and 5 Momentum Biases were executed.

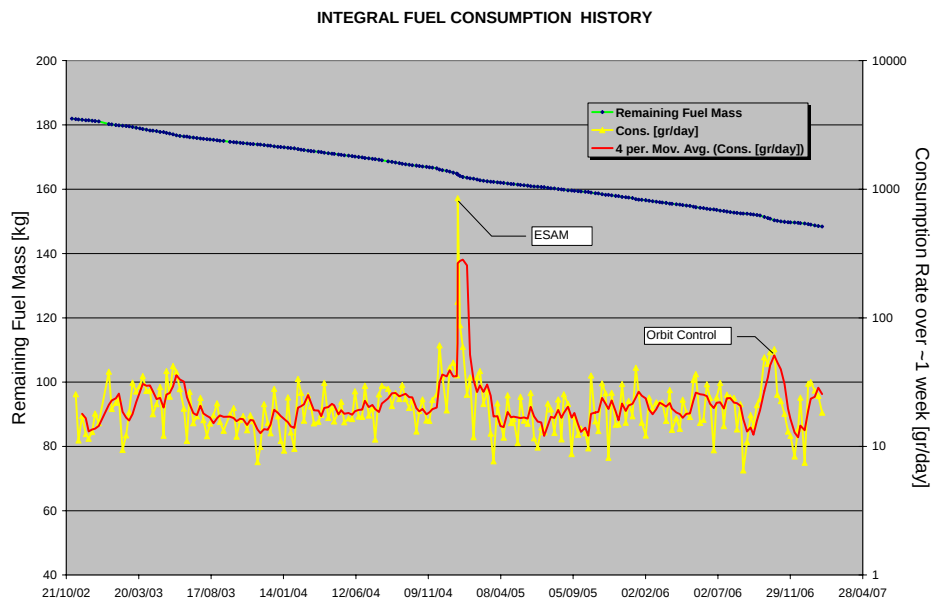
No slews were missed from the TL during the observation period

Orbit Control

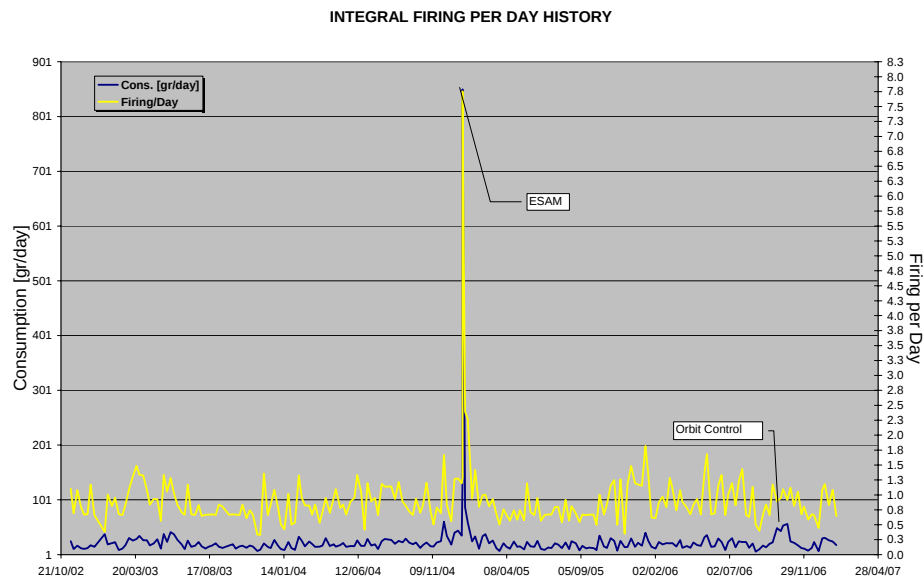
No update.

Fuel consumption

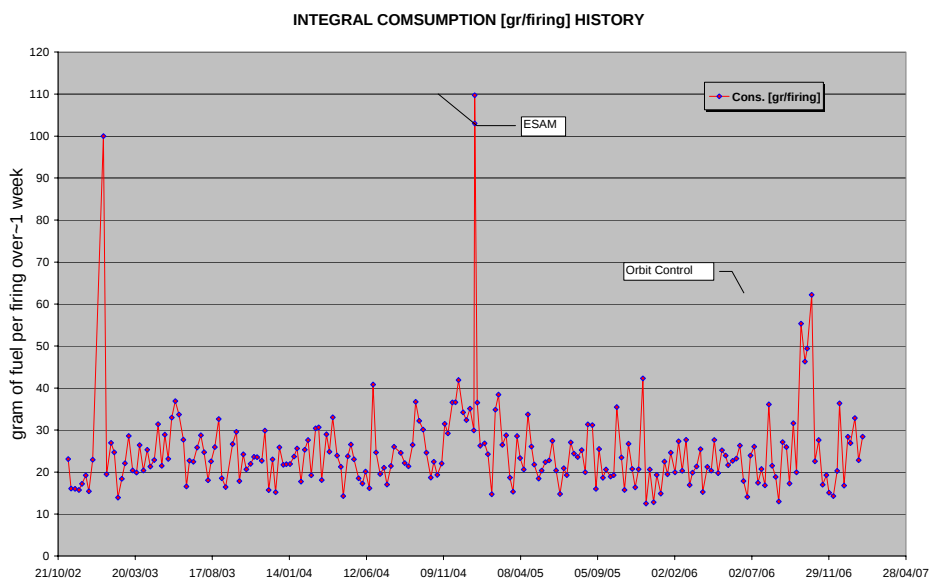
The fuel consumption (total, grams/day) over the period between 01/11/2002 and 02/02/2007 is reported in the plot below.



The firing\day over the period between 01/11/2002 and 02/02/2007 is reported in the plot below.

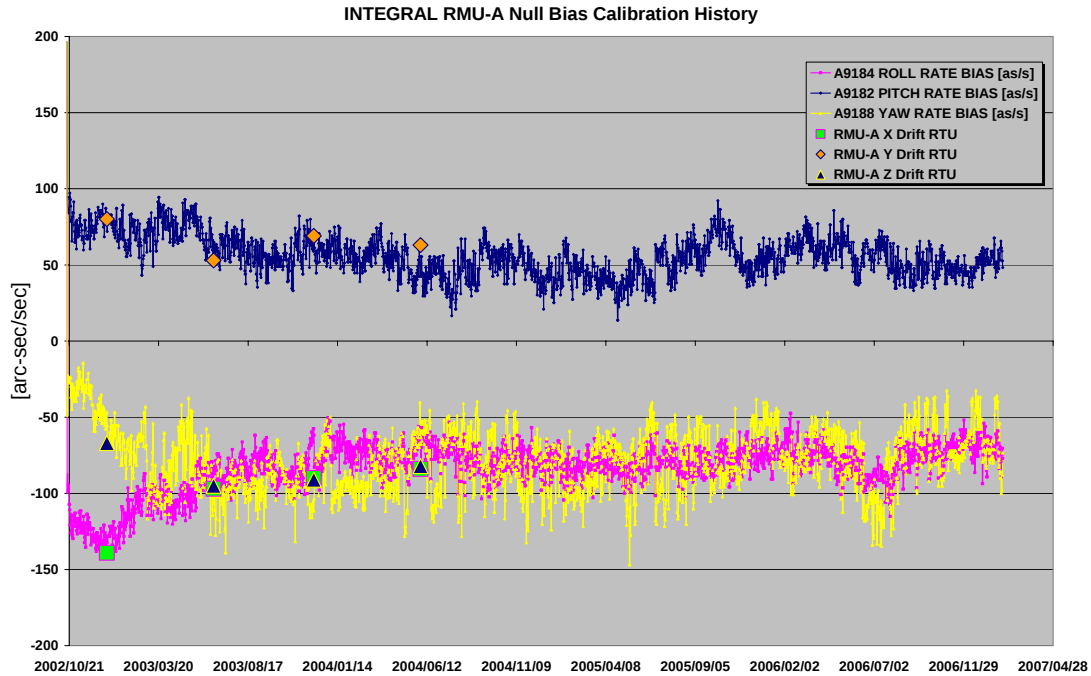


The fuel/firing over the period between 01/11/2002 and 02/02/2007 is reported in the plot below.

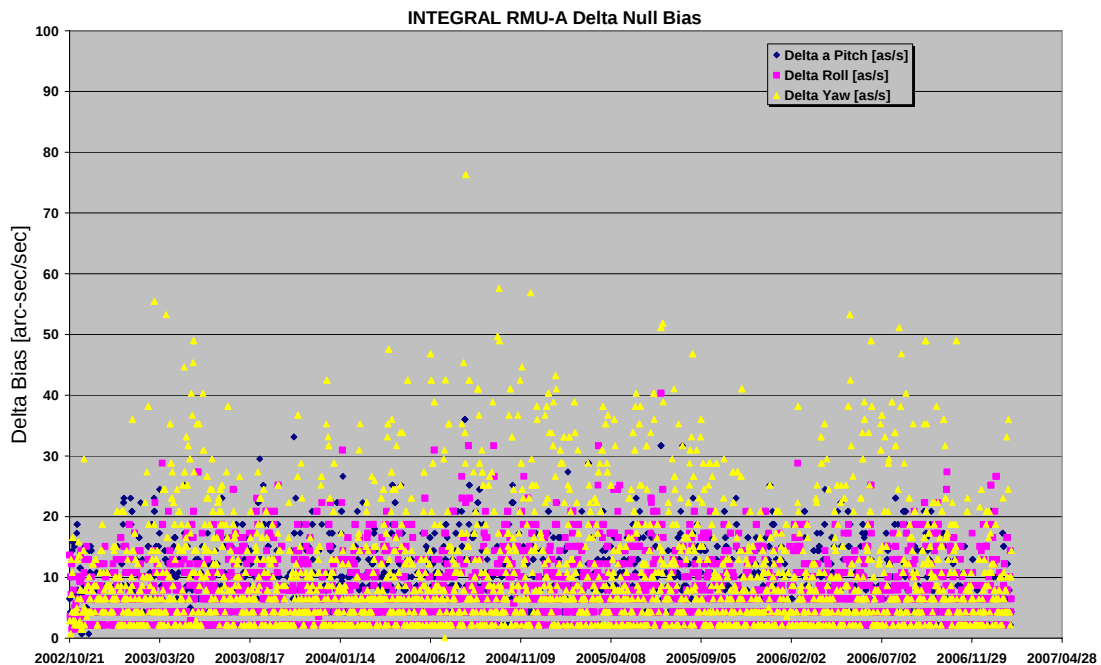


The RMU-A null bias calibration

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



27/01/07 (Day of Year 027, Revolution 523-524)

Nothing to report.

28/01/07 (Day of Year 028, Revolution 524)

Nothing to report.

29/01/2007 (Day of Year 029, Revolution 524)

Nothing to report.

30/01/2007 (Day of Year 030, Revolution 524-525)

Nothing to report.

31/01/2007 (Day of Year 031, Revolution 525)

Nothing to report

01/02/2007 (Day of Year 032, Revolution 525)

Nothing to report.

02/02/2007 (Day of Year 033, Revolution 525-526)

STR SEU threshold exceeded: at 09:22:21z during the perigee passage for rev 525, the STR SEU threshold was exceeded and the guide star was lost. As automatic reaction the ACC switched ON the IMU 1 and an automatic mapping was commanded.

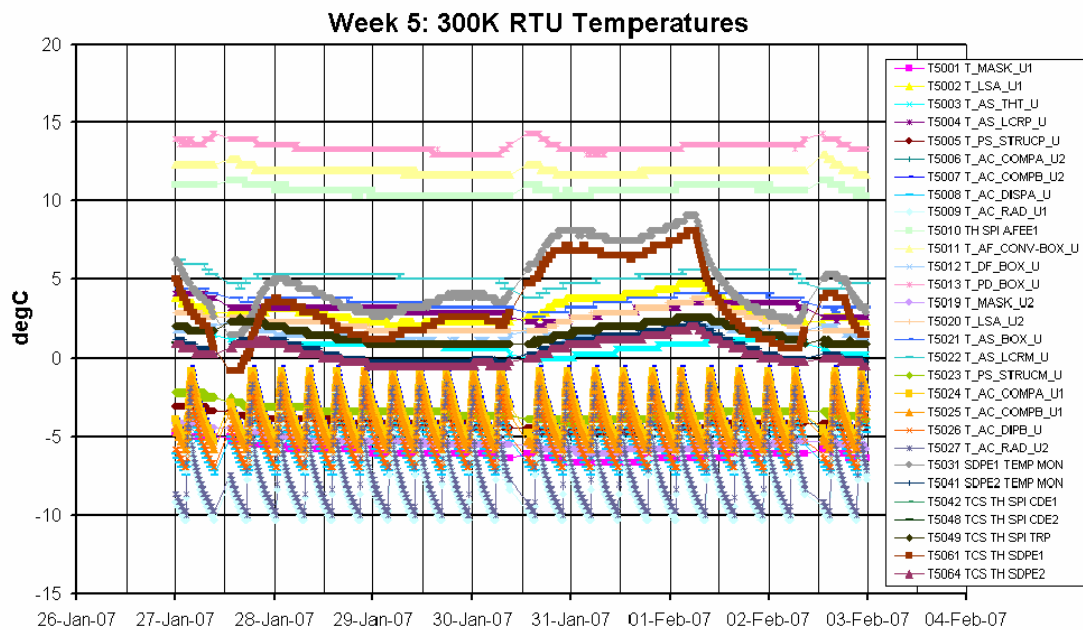
At moment of the event, the guide star was Mi 5.9 at CCD location [-19594, 12959]. A manual recovery was performed to re-set the correct guide star (ID 1545-2527) for the RWB execution and the first slew of the revolution ID 05260001 was manually update in TL.

The reason of the lost of guide star is likely due to the crossing of the electron inner Belts at about 28000 km: this caused generation of false events reported by the STR and SEU filter threshold to be exceeded.

No impact on TL reported.

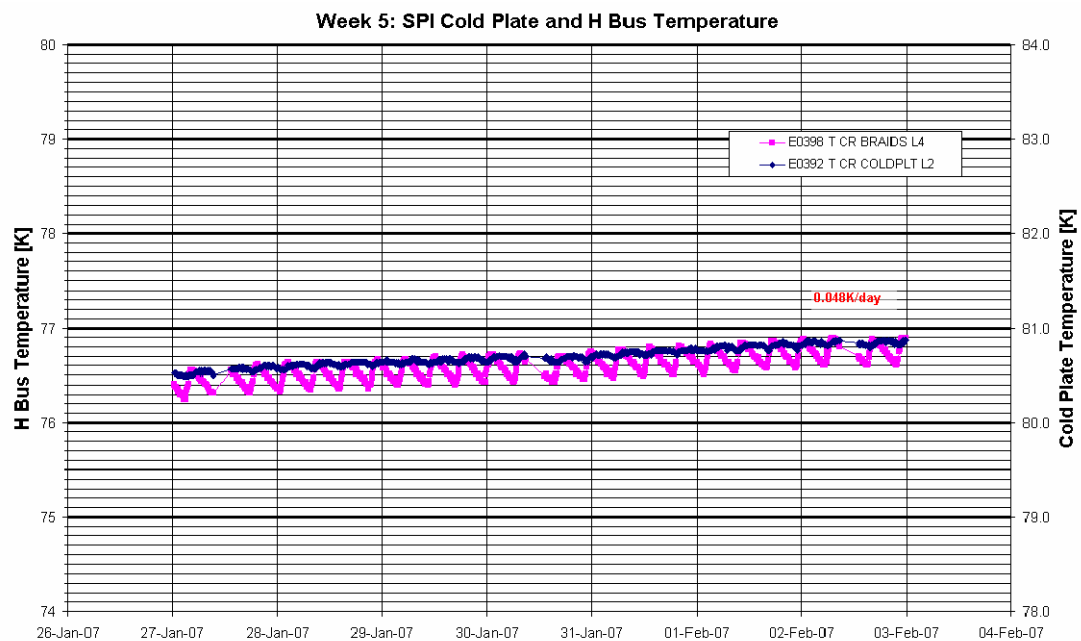
8.3.2 SPI Operations

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 $\pm$ 1K with a positive drift of 0.048K/day.

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

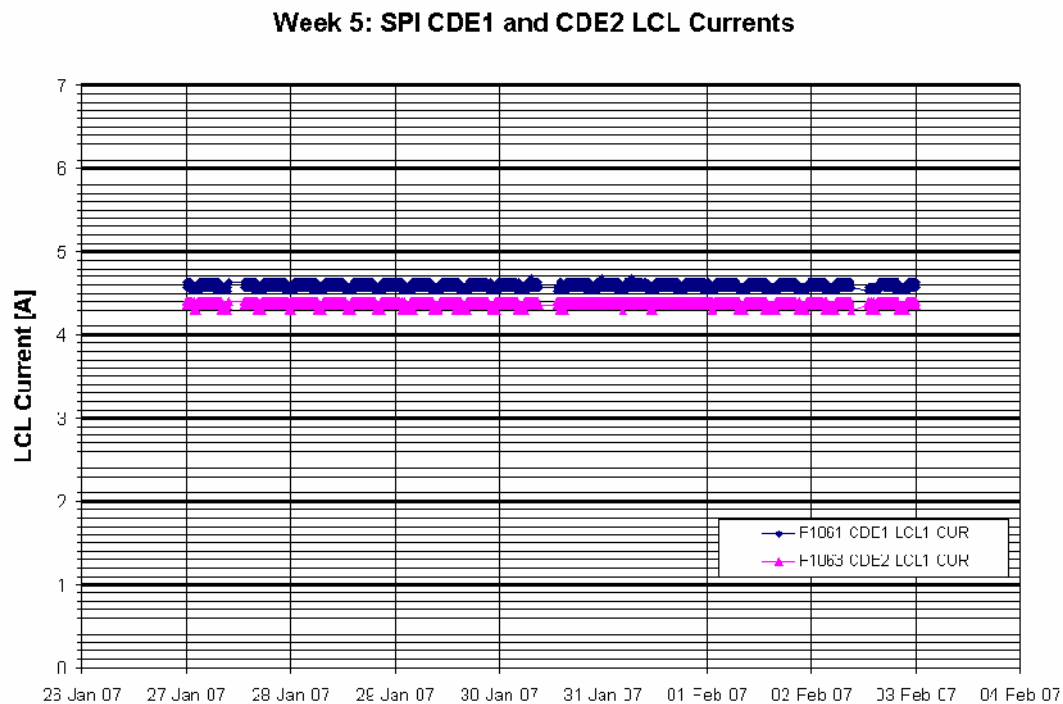


The stroke of all four compressors has remained set to 39 since 2007-01-19.

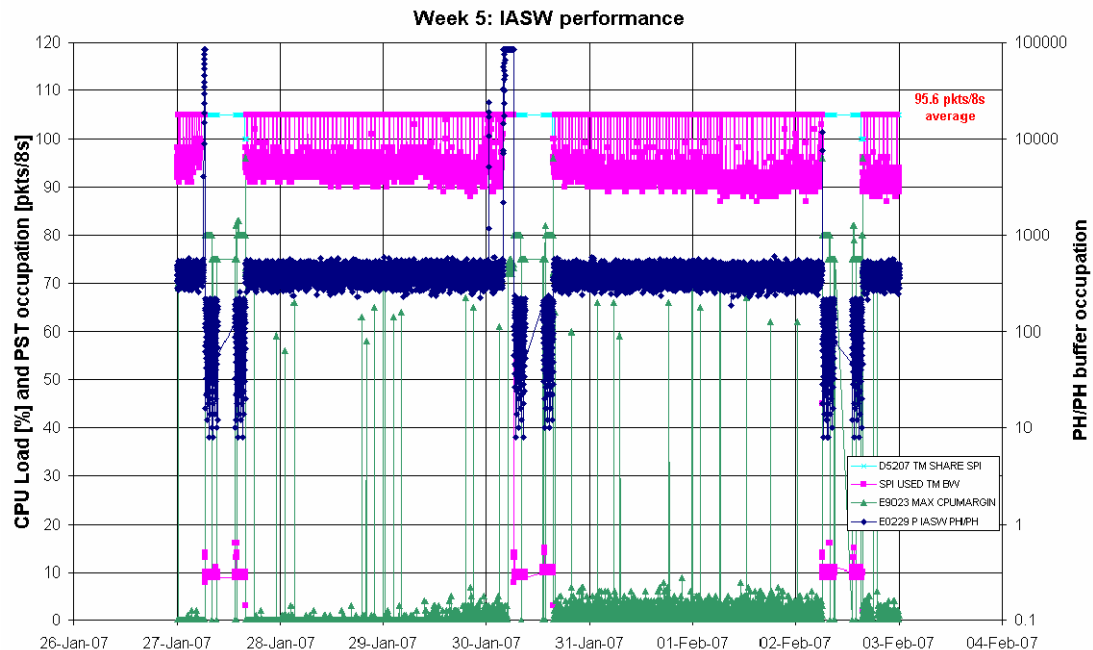
The average LCL currents of the CDEs over the week were:

- Average CDE1 LCL Current = 4.59A
- Average CDE2 LCL Current = 4.37A

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

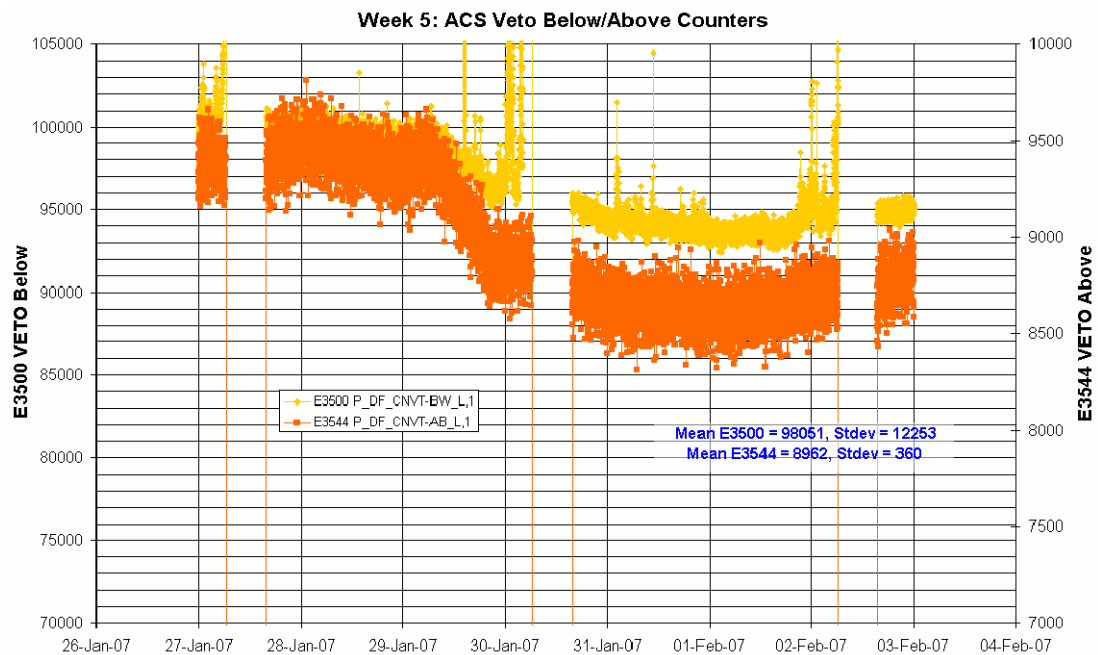


DPE & IASW: The DPE health and IASW performance is nominal. The current IASW version installed is 432. The average TM bandwidth occupation of SPI was 95.6 packets/cycle over the science window, when the TM allocation was 105 packets/cycle. The following plot shows the IASW performance in terms of TM 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:

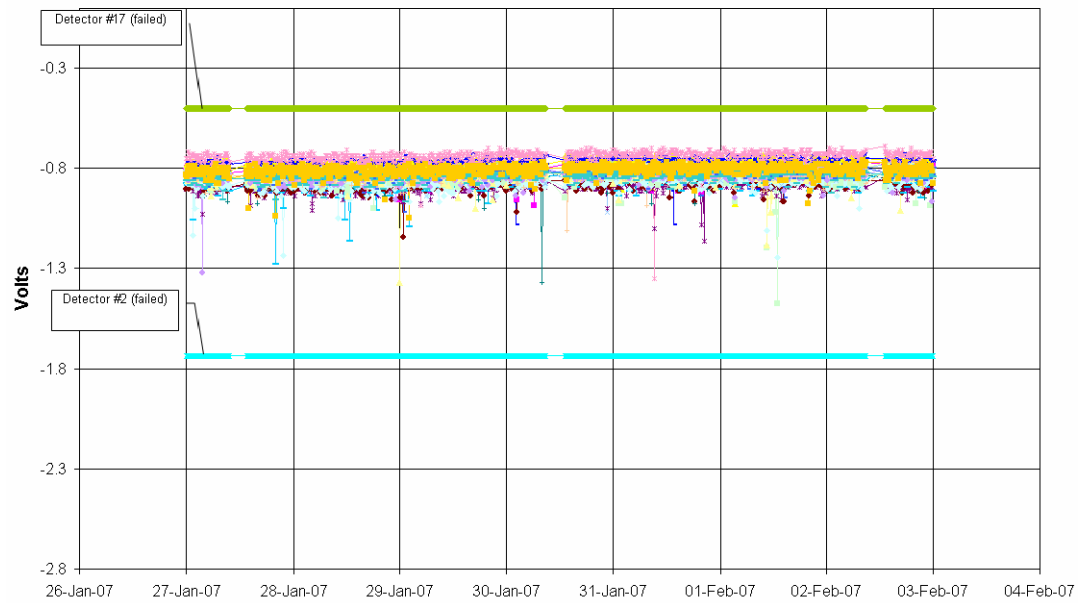


AFEE: The health of the AFEE is nominal. The performance of the AFEE and the detectors is nominal, except for the Ge detector #12 which is showing a slightly degraded energy resolution. The energy resolution of GeD#4 was recovered with the last annealing.

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

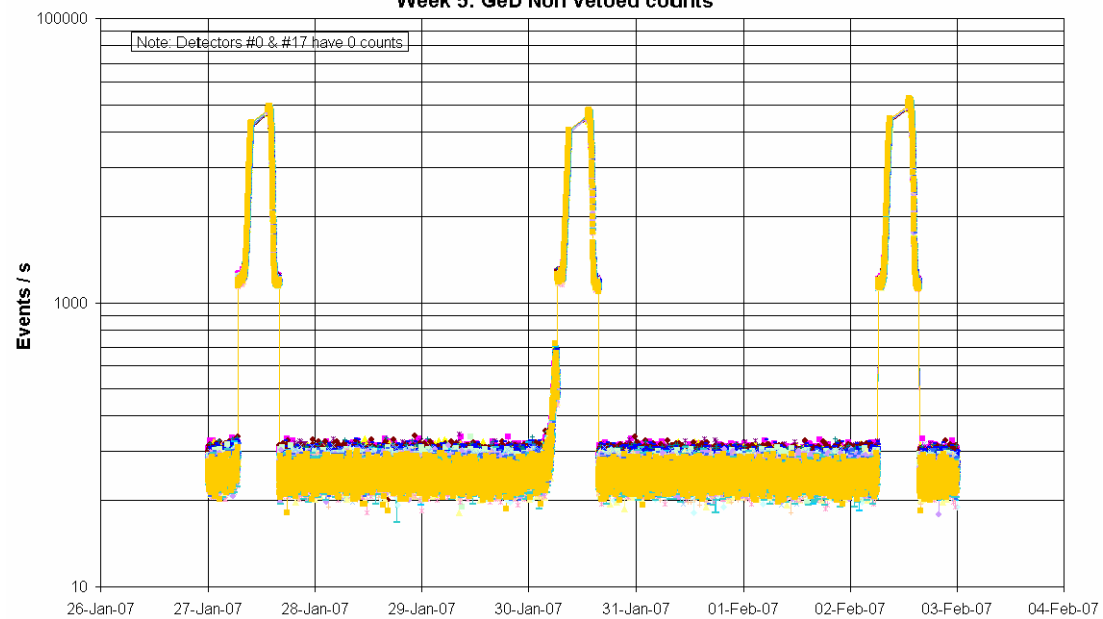
The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004.

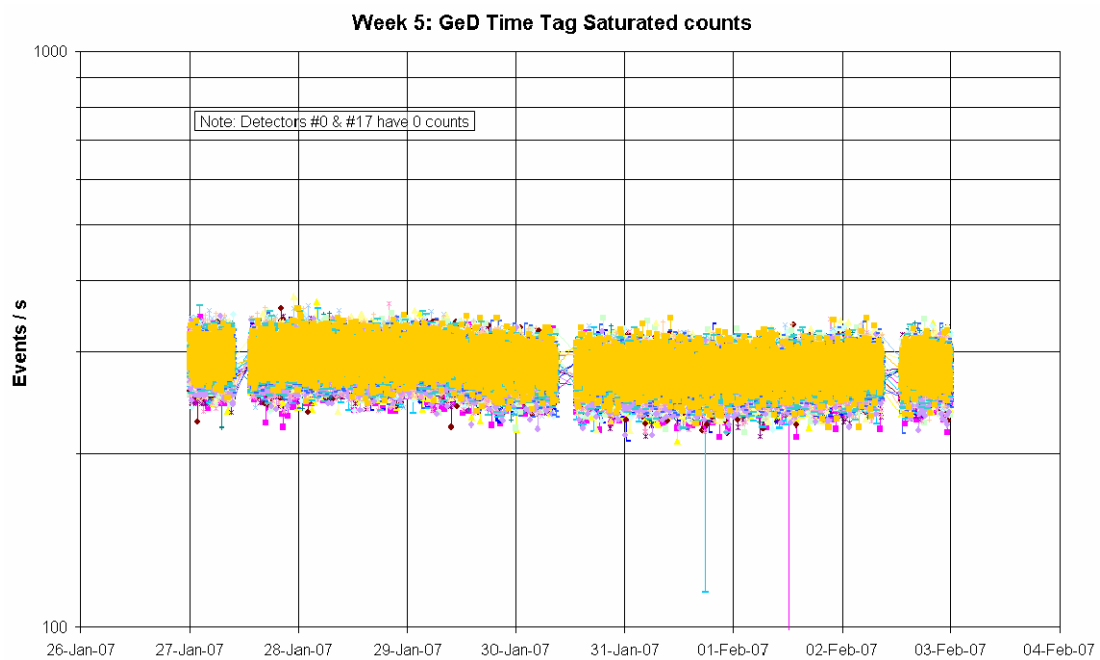
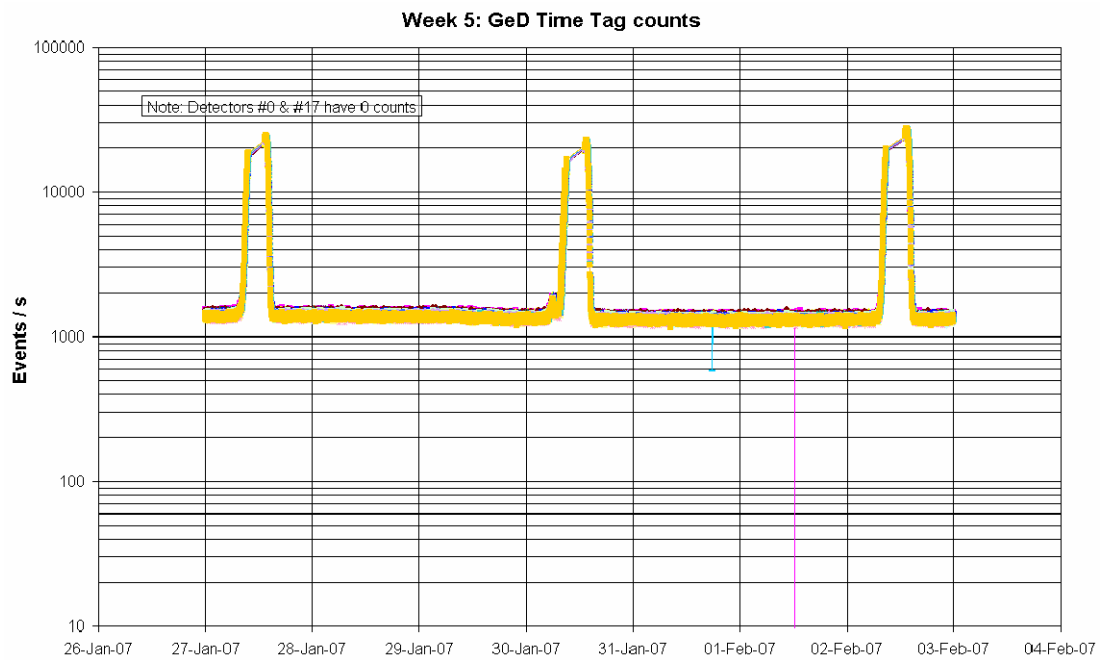
Week 5: AFEE DC output Voltages



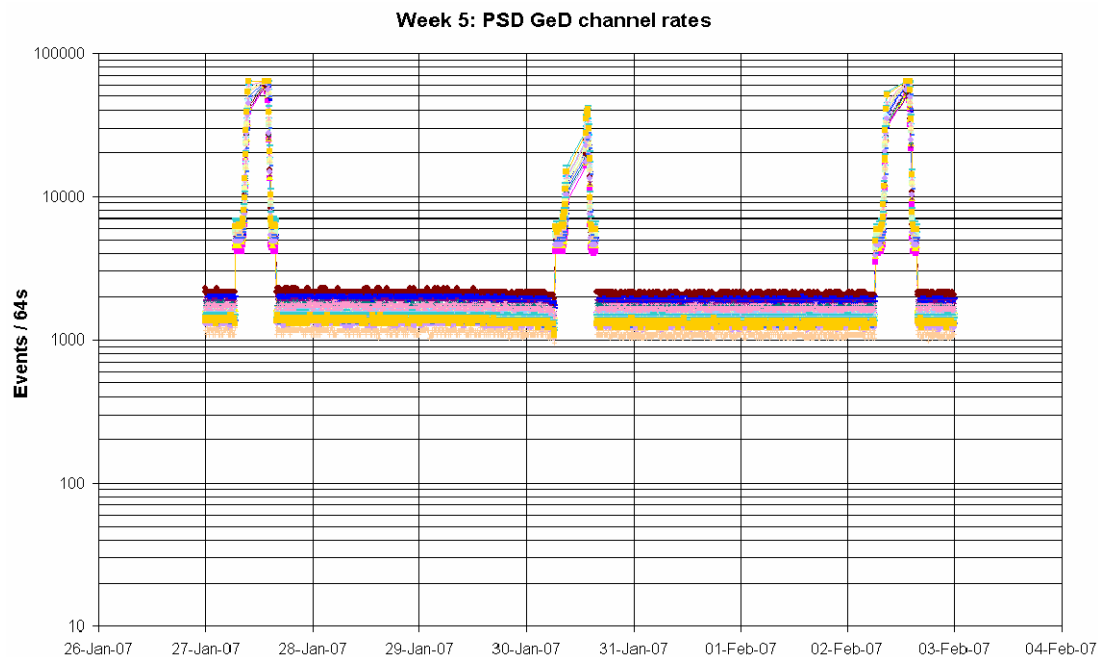
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event Count Rates during the reporting period.

Week 5: GeD Non Vetoed counts





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



Event Log:

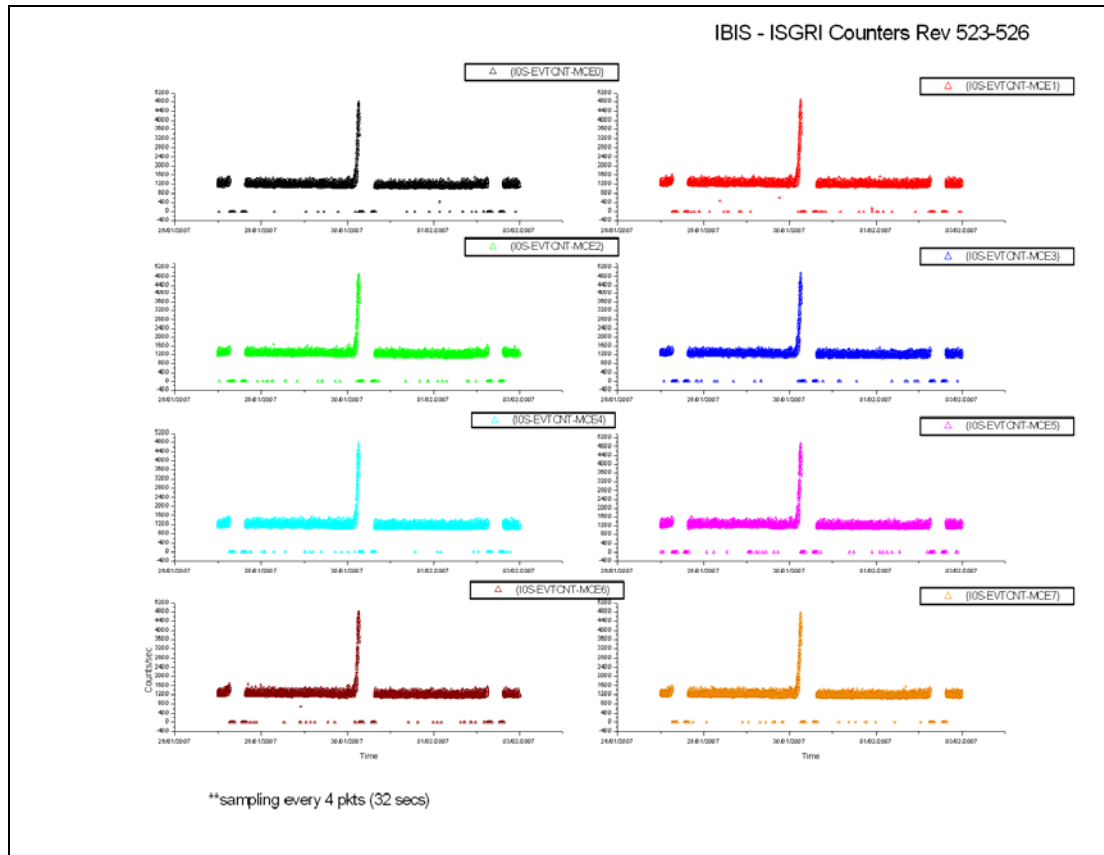
The following non-nominal events occurred on SPI during the reporting period:

- On 2007-01-27 at 06:10:11Z the TM parameter E3500 P_DF_CNVT-BW_L started going OOL High. This was ~25 minutes before radiation belt entry of revolution 523 and therefore no action was taken.
- On 2007-01-30 at 03:23:31Z the TM parameter E3500 P_DF_CNVT-BW_L started going OOL High. This was ~3 hours before radiation belt entry of revolution 524 and no action was taken.
- On 2007-01-30 from 05:55:38Z to 06:11:06Z several occurrences of OEM 1024 ID 229 EXCEPTION SPI1 PARTIAL FLAG OVERFLOW were received. This was just before radiation belt entry of revolution 524 and the OEMs stopped of their own accord.
- On 2007-02-02 at 05:57:55Z the TM parameter E3500 P_DF_CNVT-BW_L started going OOL High. This was ~10 minutes before radiation belt entry of revolution 525 and therefore no action was taken.
- On 2007-02-02 at 08:32:18Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. This was during the LOS_CHK window of revolution 525, when the SPI1 DPE time verification TC was sent. This OEM is sometimes received when this TC is sent and no action was taken.
- On 2007-02-02 between 13:17:10Z and 13:33:18Z the TM parameter E4009 S DF HSLERR L went OOL several times, indicating errors on the HSL. This was during the AOS_CHK window of revolution 526.
- 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.

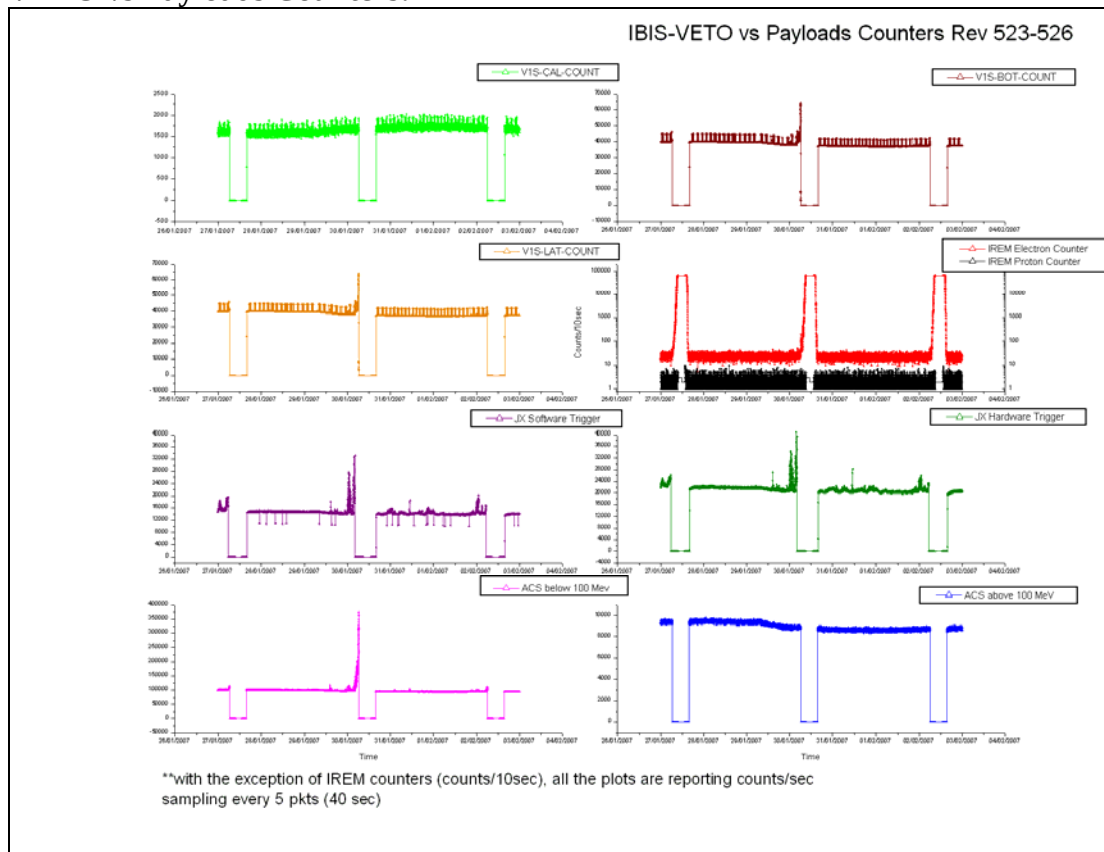
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

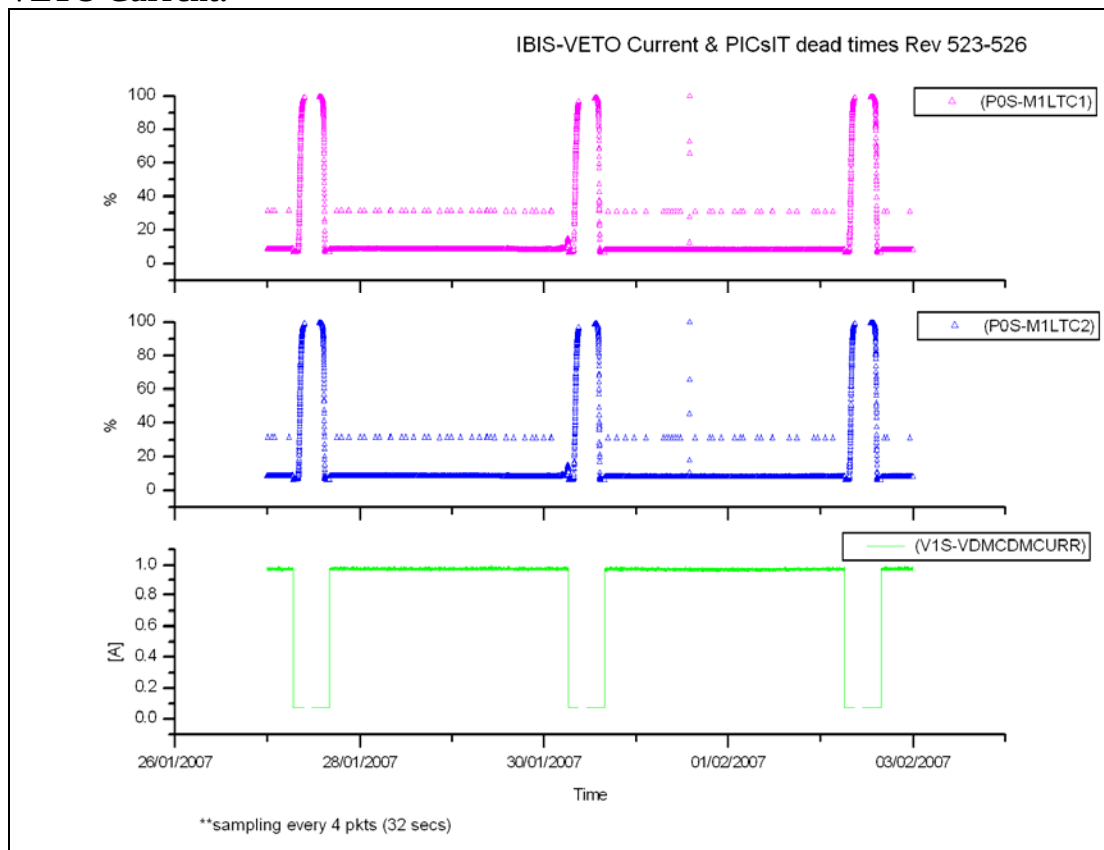


VETO vs Payloads Counters:

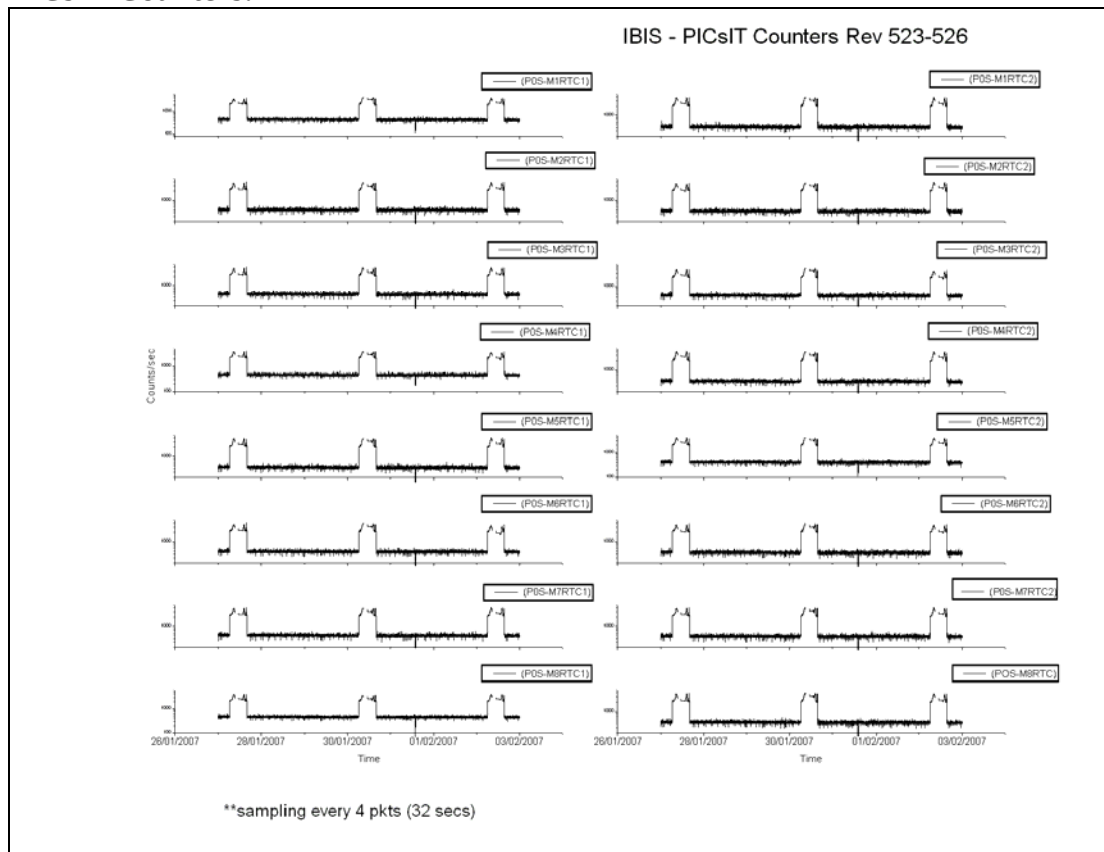


The week was characterised by low radiation.

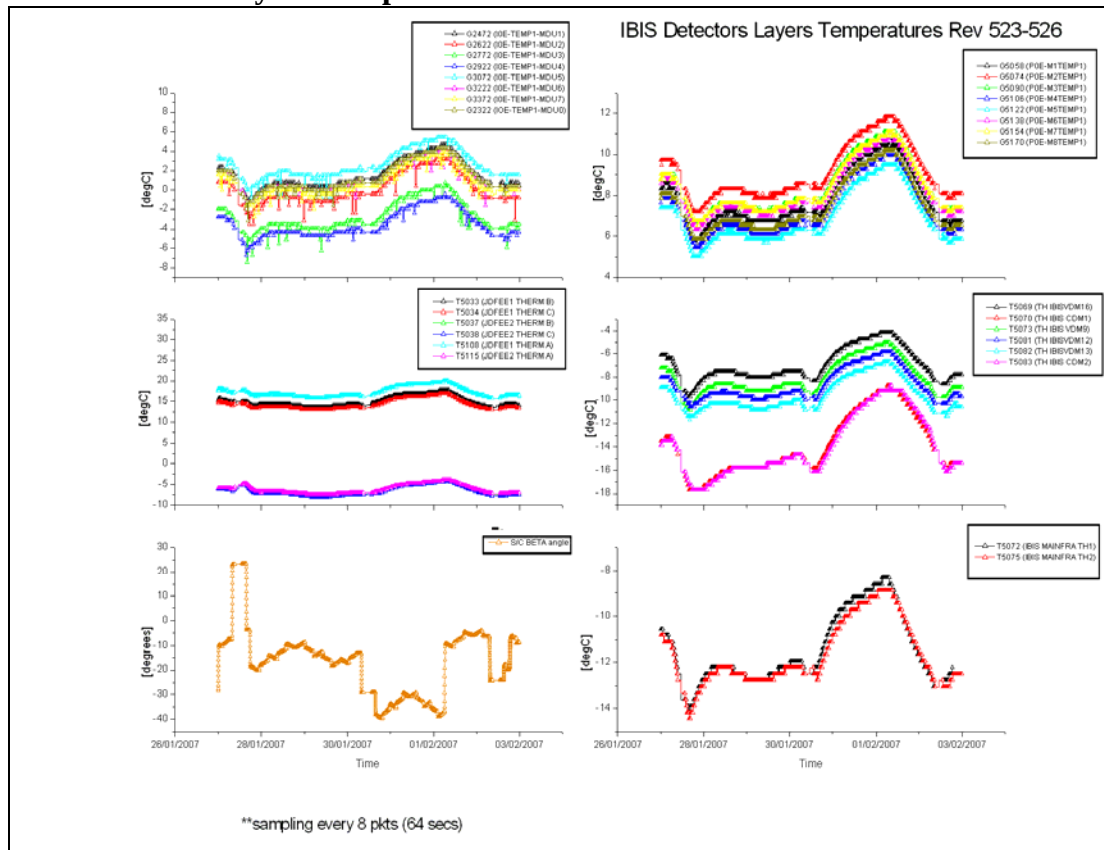
VETO Current:



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 2007.027 (27/01/2007):

TM parameter G6061 (V1S-CAL-COUNT) was reported toggling OOL low. This is due to the decay of the radioactive source in the VETO Calibration module. Therefore no action was taken. An adjustment of the low limit will be performed in the next database release.

At 08:28Z, while IBIS was in Stand-By configuration inside the Radiation Belts window, TM parameter G5079 (P0E-M2 ASICLINE) was reported OOL High for one TM cycle. No action was taken as per F-DIR.

DoY 2007.030 (30/01/2007):

From 03:53Z TM parameter G8080 (S1E-VS_HBRA-RT) was toggling OOL High.
At 05:17Z, TM family G2013 (I0S-EVTCNT-MCEi) started toggling OOL High.
At 06:06Z TM parameters G6062 (V1S-BOT-COUNT) and G6063 (V1S-LAT-COUNT) started toggling OOL High.
All these events are related to high radiation as the S/C was approaching the Belts. No action was taken as per FDIR.
They all came back into nominal range at 06:24Z when IBIS went to Stand-By mode due to radiation Belts entry scheduled in timeline.

DoY 2007.031 (31/01/2007):

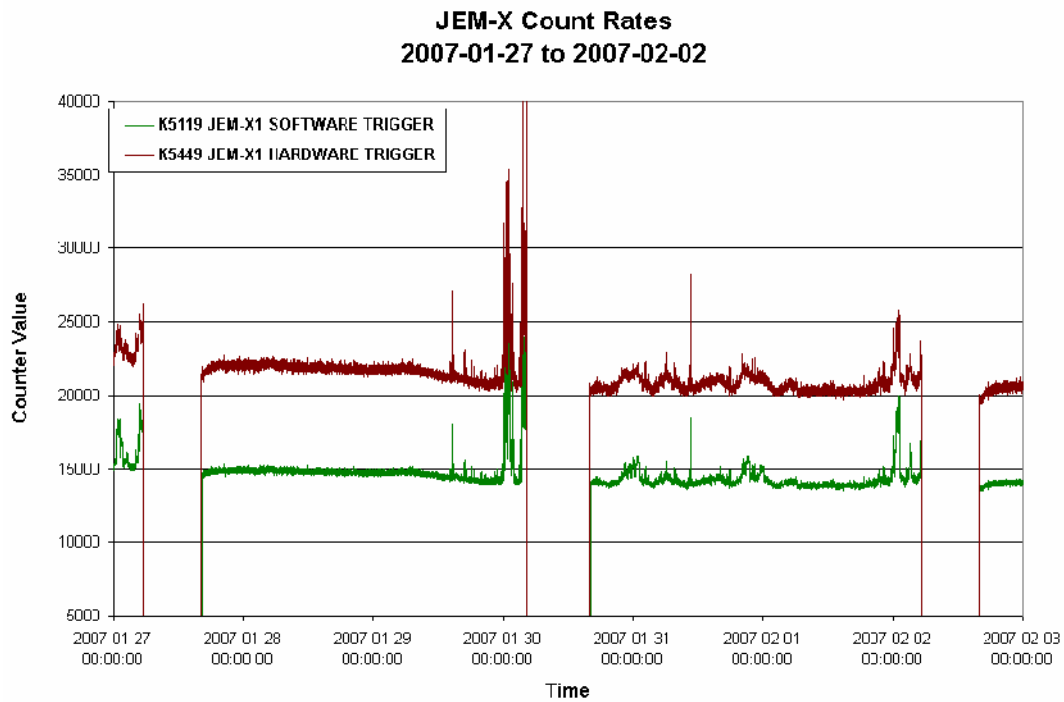
At 13:54Z several parameters from TM families G5068 (P0S-MiF1ERRF) and G5072 (P0S-MiF2ERRF) were reported failing Status Consistency Check.
At the same time, several parameters from G5002 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2) were reported OOL LOW-LOW (value =0 cnt/s).
At 13:57Z the On Event Message APID 1280, ID 132, class 0, "IBIS1 IASW HEPI RESYNCHRONIZED" was reported.
The coincidence of these 3 events is acceptable according to FDIR.

8.3.4 JEM-X Operations

JEM-X Count Rates

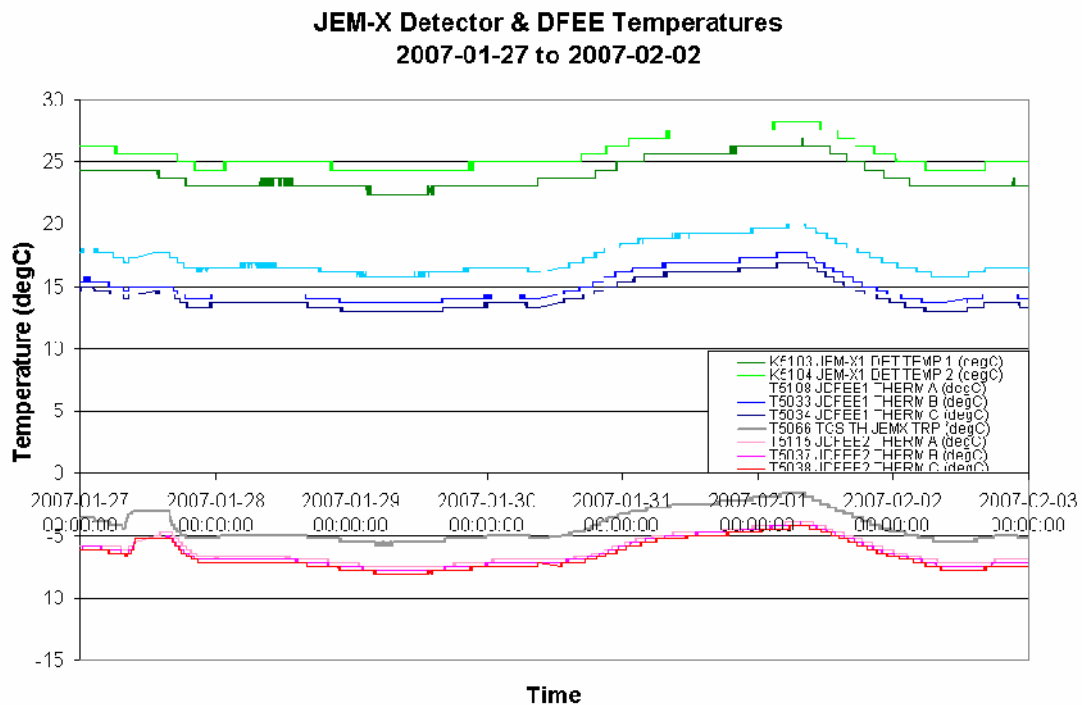
JEM-X count rates over the reporting period are displayed in the following graph¹.

¹ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.



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.



² Data sampled (1 frame in 8)

JEM-X Daily Report

2007-01-27 (DOY 027, Rev 523-524) to 2007-01-28 (DOY 028, Rev 524)

JEM-X1 operations executed nominally.

2007-01-29 (DOY 029, Rev 524) to 2007-01-30 (DOY 030, Rev 524-525)

Due to high background radiation conditions, on 2007-01-29 at 23:58Z the TM parameters K5136 BUFFER LOSS and K5449 HARDWARE TRIGGER started toggling OOL High. On 2007-01-30 at 03:37:43Z K5119 SOFTWARE TRIGGER also started to toggle OOL High and at 04:12:42Z 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) was received at this time, as the TM parameter K5462 DFEE STATE IASW was reporting state Setup while K5022 DFEE STATUS was Safe. At 04:15:14Z 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.

2007-01-31 (DOY 031, Rev 525)

At 10:51:11Z TM parameters K5136 BUFFER LOSS and K5449 HARDWARE TRIGGER briefly went OOL High, returning within limits at 10:51:27Z.

JEM-X1 operations continued nominally.

2007-02-01 (DOY 032, Rev 525) to 2007-02-02 (DOY 033, Rev 525-526)

JEM-X1 operations executed nominally.

8.3.5 OMC Operations

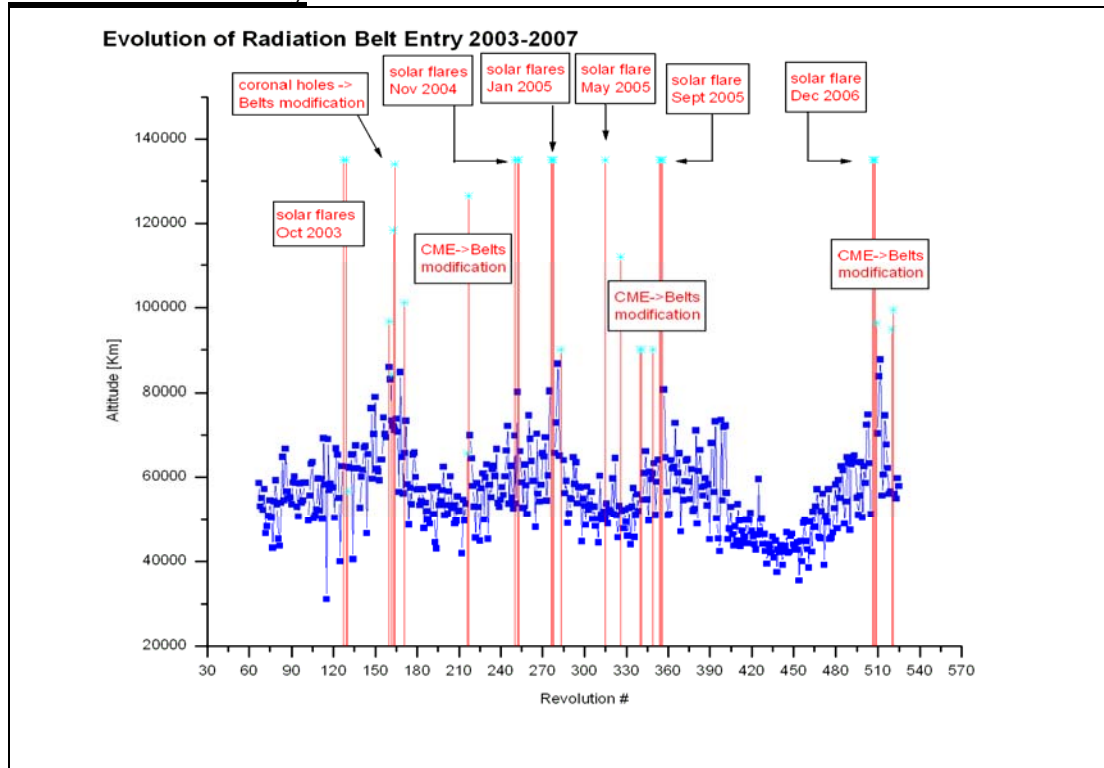
2007-01-27 (DoY 027, Rev 523) to 2007-02-02 (DoY 033, Rev 526)

Nothing to Report

On DoY 027 at 06:36:25, DoY 030 at 06:23:45 and DoY 033 at 06:11:53 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]
523	RAD_ENTR R 2007-01-27T06:36:23Z	2007-01-27 06:42:07	54955.5	2007-01-27 07:32:55	48170
524	RAD_EXIT R 2007-01-27T15:53:35Z	2007-01-27 15:01:19	<<43411.8	2007-01-27 15:32:55	42082
524	RAD_ENTR R 2007-01-30T06:23:43Z	2007-01-30 05:59:11	59772.0	2007-01-30 07:17:59	48471
525	RAD_EXIT R 2007-01-30T15:40:29Z	2007-01-30 14:56:07	<<43046.3	2007-01-30 15:17:59	41830
525	RAD_ENTR R 2007-02-02T06:11:45Z	2007-02-02 05:57:19	57919.4	2007-02-02 07:07:59	48155
526	RAD_EXIT R 2007-02-02T15:28:17Z	2007-02-02 14:48:23	<<42516.8	2007-02-02 15:07:59	42188

Reference

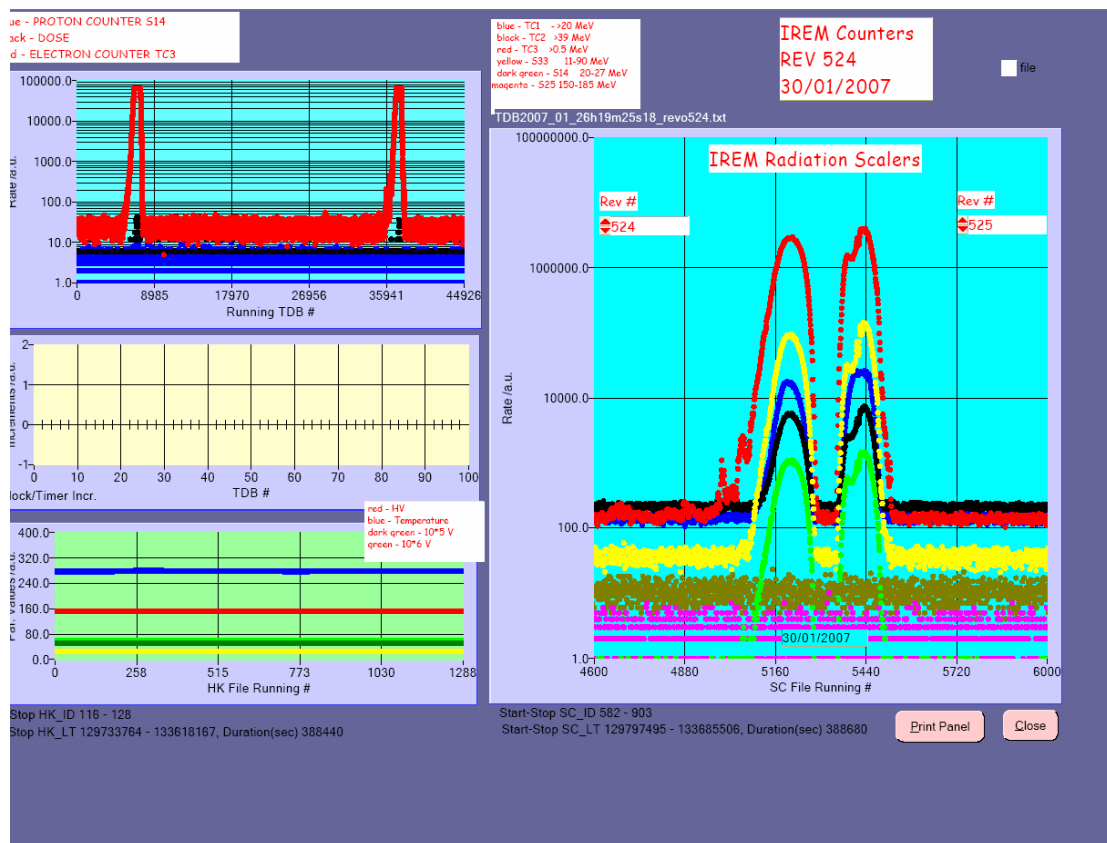
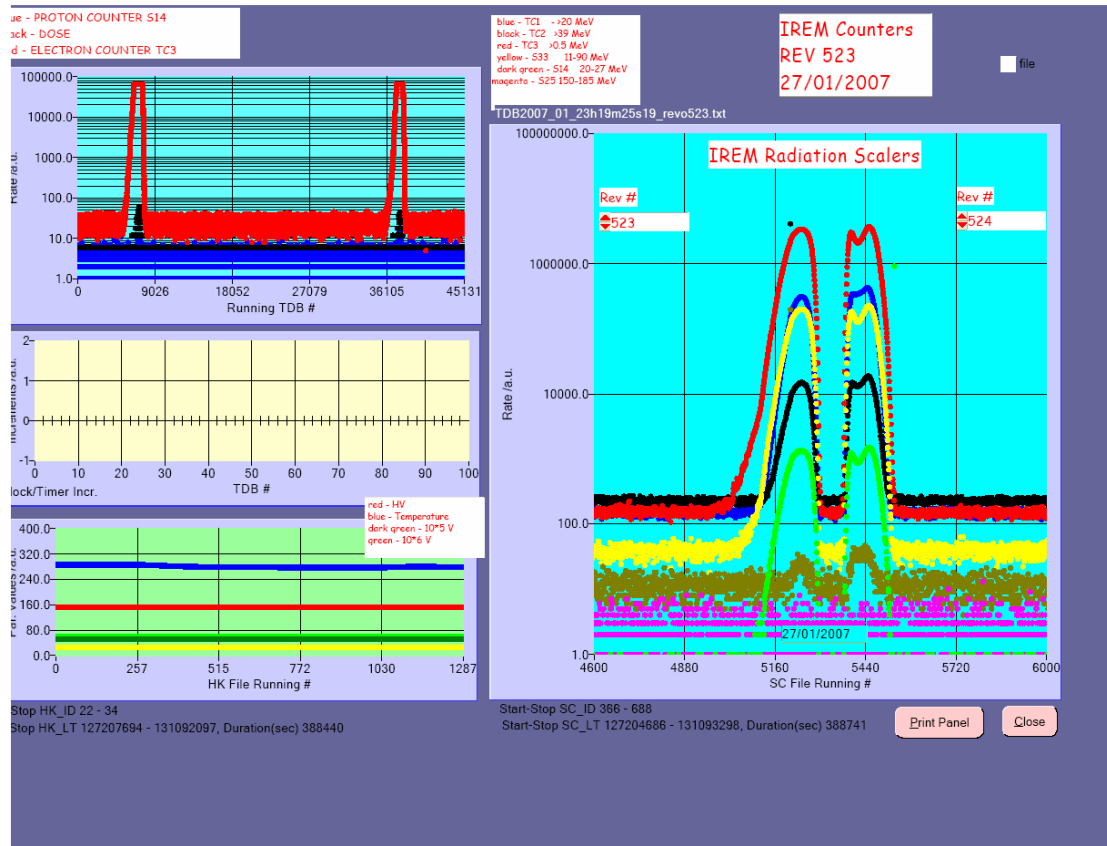
Very small error vs reference (less than 10 minutes)

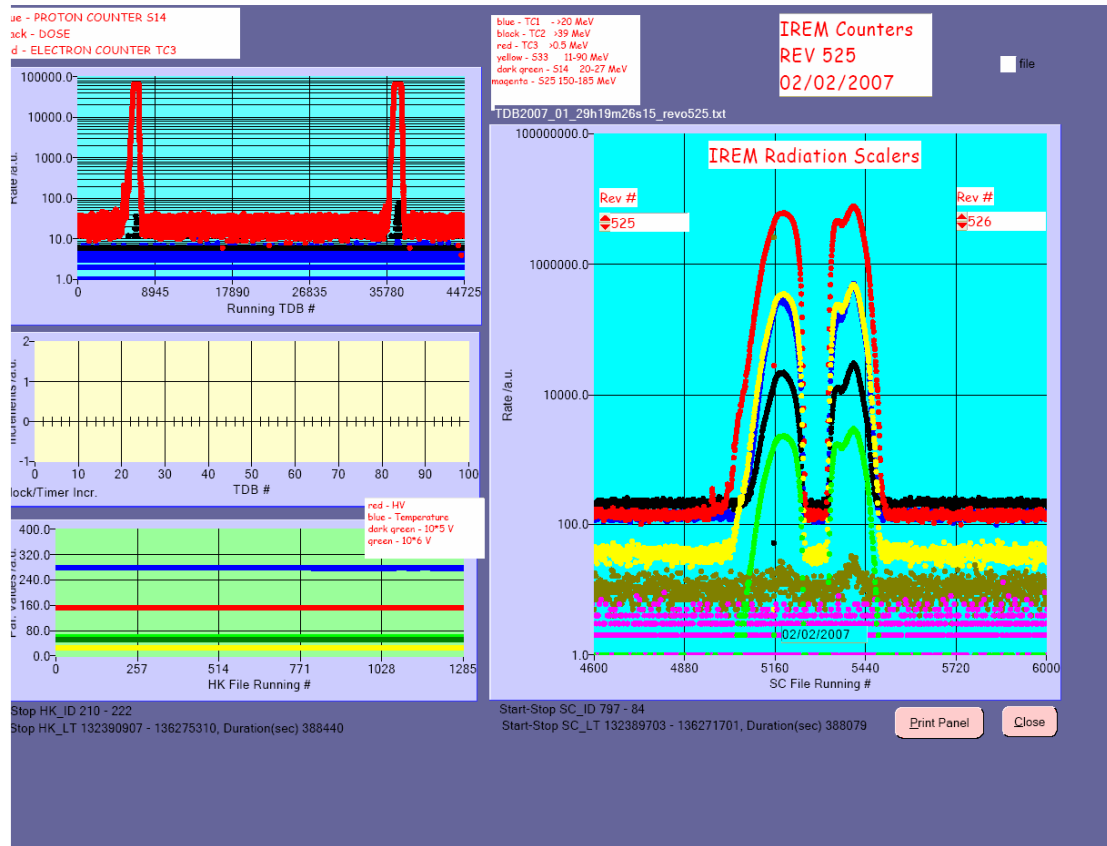
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

Radiation Spike

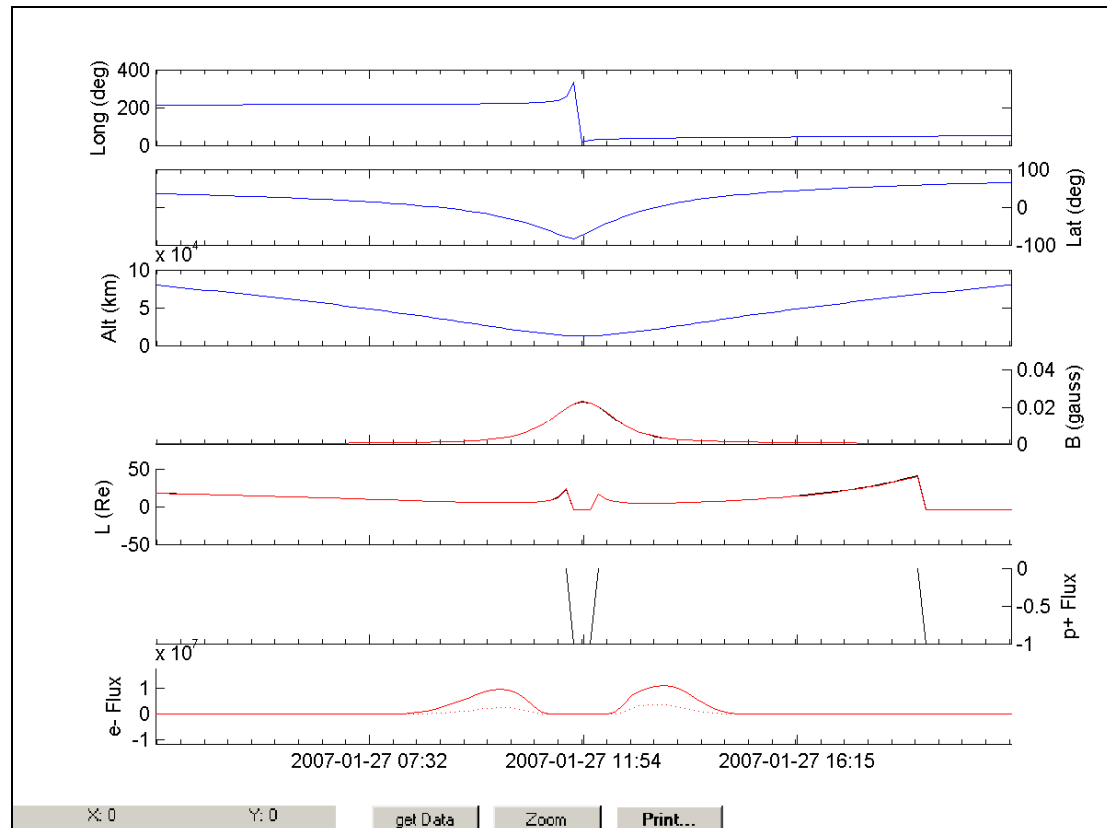
IREM radiation counters:



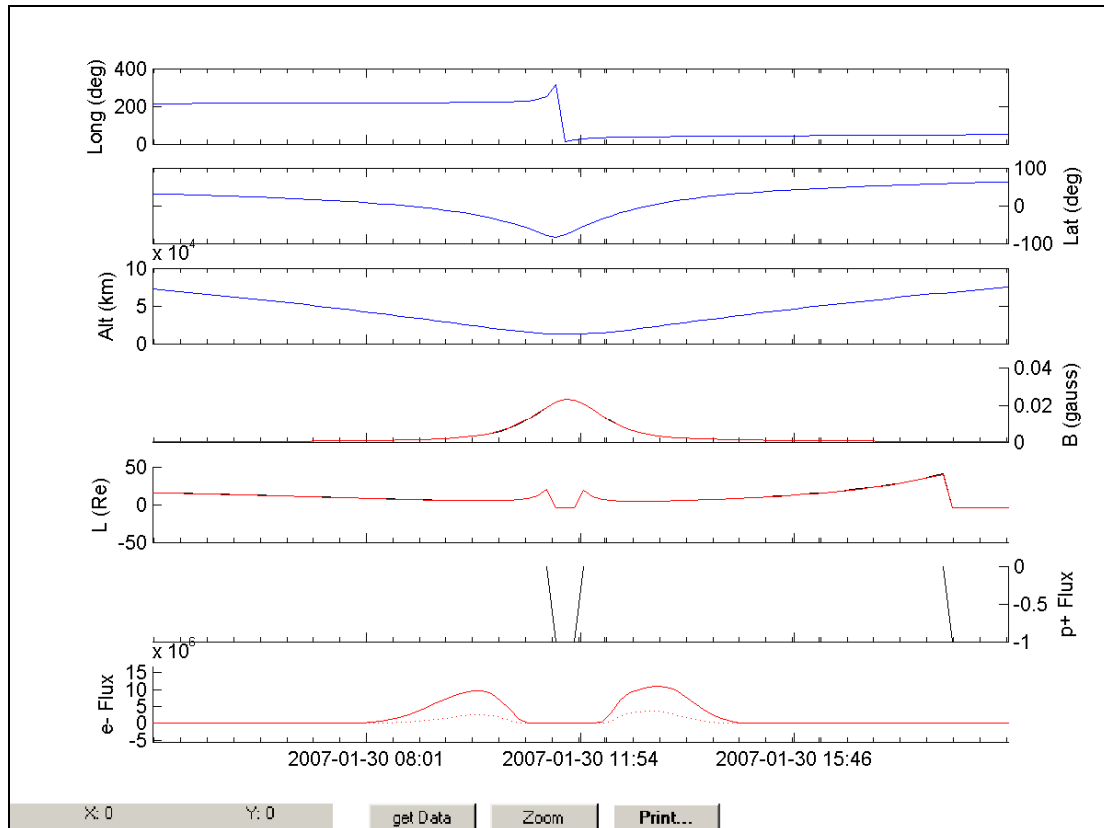


IREM Predicted Radiation Belt Passages

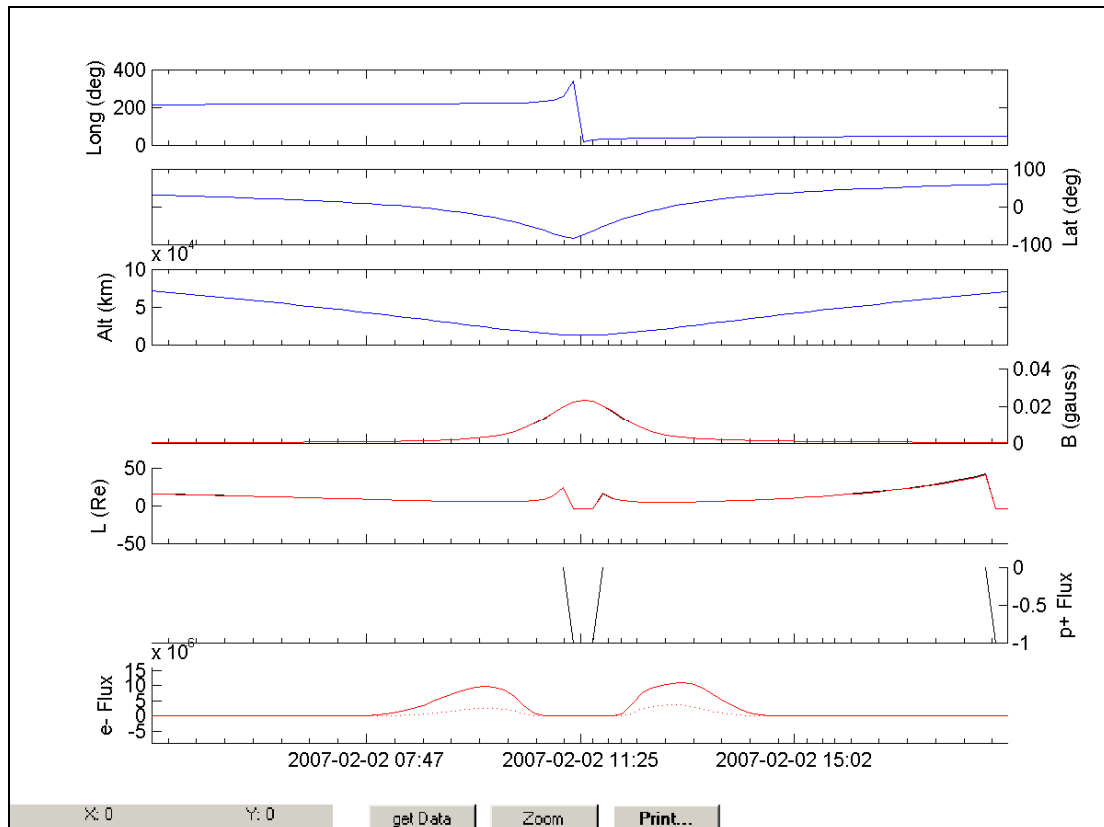
Rev 523



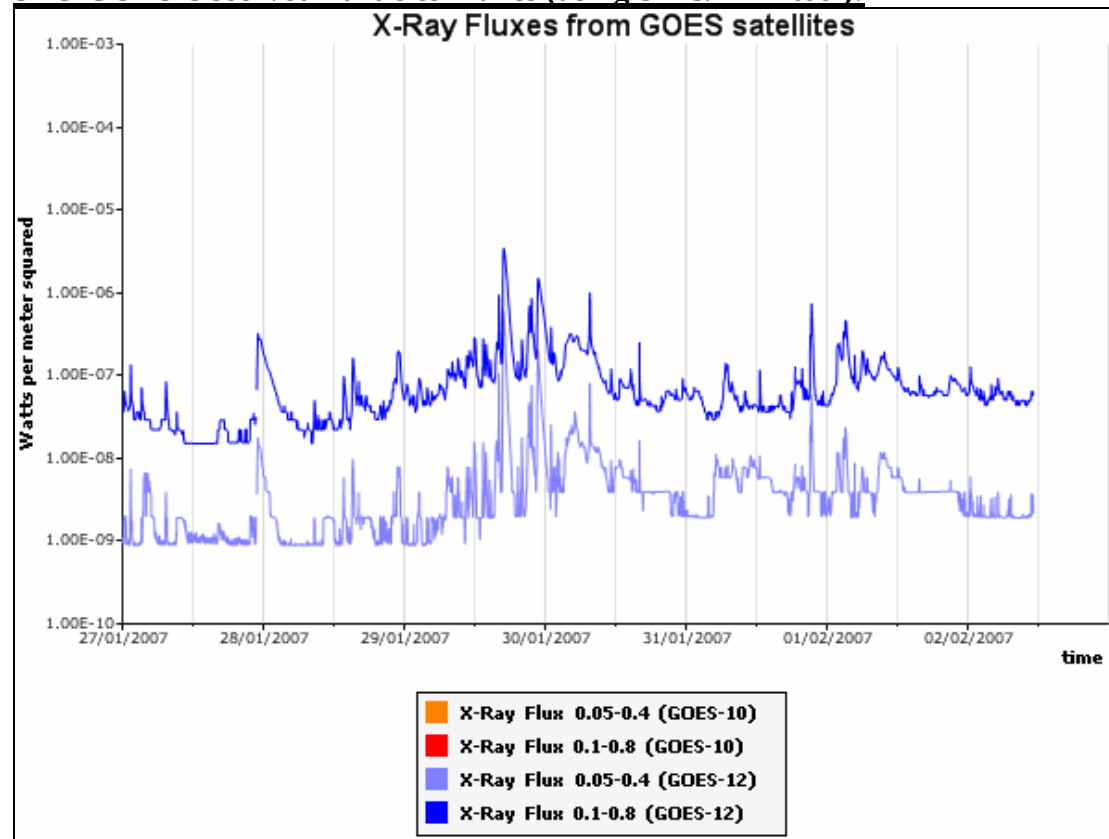
Rev 524



Rev 525



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



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

The radiation flux plot is not available this week. But the background was essentially low.