

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 281
Week 06
11.02.08
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 02.02.08 until 08.02.08 (both dates inclusive) and covers the revolutions 648, 649 and 650.

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 Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), 2 Galactic Disk Latitude Scan at attitudes (RA 14:26:48.00, DEC -58:36:00.0) and (RA 14:25:57.60, DEC -62:55:12.0), a raster dither of SN 2008S (RA 20:34:45.35, DEC +60:05:59.6), which was a Target of Opportunity, 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.

One slew was missed from TL, during the observation period due to problem with the attitude reconstruction process.

The fuel consumption over the period between 01/02/2008 and 06/02/2008 was 0.1294Kg. The remaining propellant is in the order of 142.4052 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.

A PST with an over-allocation of 3 packets - all of which were assigned to SPI - was in use for the following times:

- 2008-02-01T09:15:23 to 2008-02-02T12:06:09
- 2008-02-05T16:12:16 to 2008-02-08T11:40:10
- 2008-02-08T14:49:01 to 2008-02-09T23:25:05
- 2008-02-09T23:31:17 to 2008-02-11T11:30:13

No build of TM buffer occupancy was observed, SPI used the extra allocation for about 35% of all TM cycles.

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

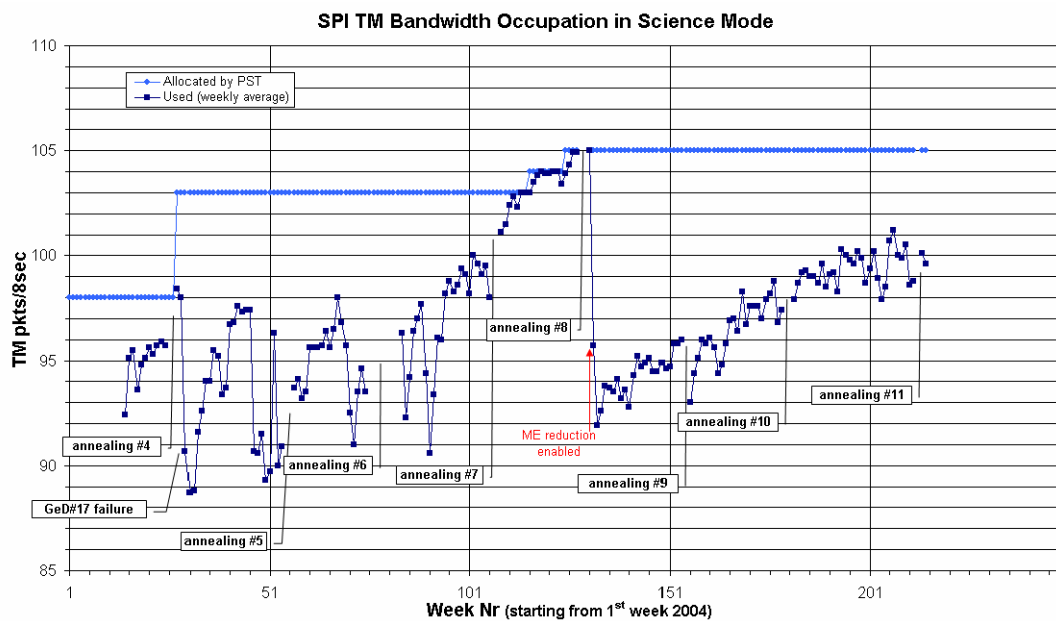
3.2.1 SPI

Following the 11th annealing, which ended on 30th January, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #12 which, although its energy resolution improved since the previous annealing, is still showing a slightly degraded energy resolution compared to the other detectors 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, however in revolutions 647 and 649-650 the over-allocated PST with 108 packets/cycle for SPI was used. The average telemetry occupation in the science windows was 99.6 packets/cycle.

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



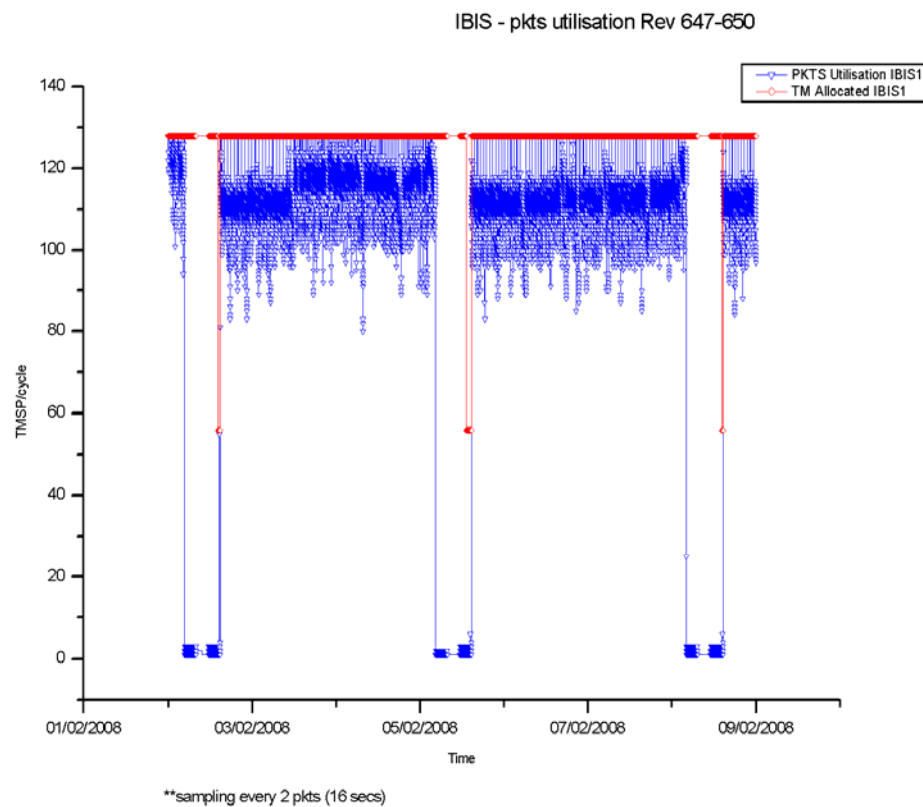
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

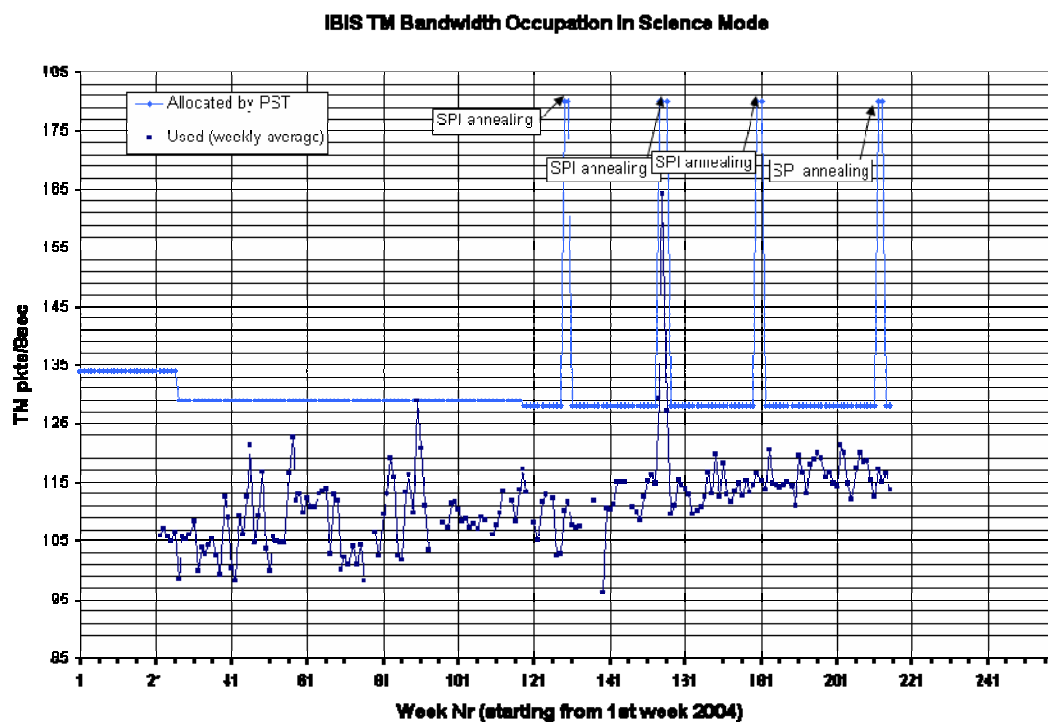
The overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS above the radiation belts was 128 packets/cycle. The IBIS mean bandwidth utilisation during the observation period (when IBIS was in Science mode) was 113.69 packets/cycle, down 2.77 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 168 planned science pointings for OMC were executed nominally.

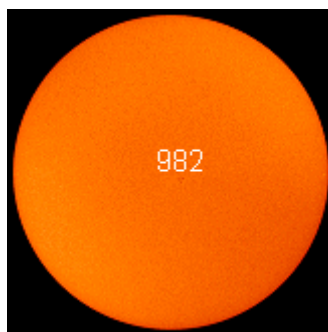
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. Sunspot #982 was present until the 5th February, the rest of the week the sun was blank. There was only a 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. No pointings were lost to ground problems. The overall performance was nearly 100%.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. No problems were reported that affected operations.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There was, however, one occasion where the links with Redu dropped, one occasion where the links to Goldstone dropped, and one occasion where the links to ISDC dropped, all without impact.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 657-658. The PSF for revolution 650 was updated to avoid having an overlapping RWB and handover window.

Revolution 650 was re-planned on Monday to accommodate the new PSF. This was superseded by a general re-planning of revolutions 649-654 due to a TOO on SN2008S. The timely implementation of the TOO planning already in revolution 649, despite all file exchange problems (see Problems), was only possible due to a special effort at MOC.

TSFs have been received for revolution 650 and 651.

2. Observation status

New ECSs have been received and processed for revolutions 633 and 639-642.

3. ISOC Science Data Archive

A status meeting with the support team at ESAC took place on 5 February, discussing the next ISDA release.

4. ISOC system

Version 18.0 has been intensively tested, various smaller issues have been fixed already.

5. Problems

On Tuesday morning neither IFTS nor mail worked between ISOC and MOC due to general network problems.

Revolution 654 required fiddling with the start time of an observation to avoid an - apparently rare - error condition from the Flight Dynamics software.

4.3.2 ISDC

Status of ISDC observation processing on 11/02/2008:

- Latest Standard Analysis completed: observation 05200470001 (M31, Revolutions 641 & 642) on 11/02/2008.
- Latest products archived: observation 05297000002 (3C 273, Revolutions 633 & 635) on 10/02/2008.
- Latest observation products sent to the observer: observation 05297000003 (3C 273, Revolutions 635 & 637) on 10/02/2008.

5 Special Events

6 Anomalies

There were no problems reported this week that impacted operations.

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

7 Future Milestones

The following activities are foreseen in the next few weeks.

- 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 648

The observations in revolution 648 began with a raster dither of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), lasting ~20.3 hours. They continued with a Galactic Disk Latitude Scan (RA 14:26:48.00, DEC -58:36:00.0), for ~8.3 hours. This was followed by another Galactic Disk Latitude Scan (RA 14:25:57.60, DEC -62:55:12.0), for ~8.8 hours. After this a return to the Galactic Disk Latitude Scan (RA 14:26:48.00, DEC -58:36:00.0) for ~8.8 hours was performed. Finally, a return to the Galactic Disk Latitude Scan (RA 14:25:57.60, DEC -62:55:12.0), for ~8.3 hours was executed until the end of the revolution.

Revolution 649

The observations in revolution 649 consisted entirely of a Target of Opportunity, namely a raster dither of SN 2008S (RA 20:34:45.35, DEC +60:05:59.6), lasting ~55.8 hours.

Revolution 650

The observations in revolution 650 began with the remainder of the raster dither of SN 2008S (RA 20:34:45.35, DEC +60:05:59.6), lasting ~27.5 hours. They continued with a raster dither of Orion OB1 (RA 05:17:00.30, DEC +01:47:17.7), lasting ~26.3 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

2008-01-15T13:31:36.000Z	142.7354	F	Automatic TM processing.
2008-01-16T22:51:08.000Z	142.7038	F	Automatic TM processing.
2008-01-18T13:15:05.000Z	142.6859	F	Automatic TM processing.
2008-01-19T22:57:48.000Z	142.6543	F	Automatic TM processing.
2008-01-21T13:06:08.000Z	142.6385	F	Automatic TM processing.
2008-01-22T22:23:16.000Z	142.6286	F	Automatic TM processing.
2008-01-24T12:52:56.000Z	142.5976	F	Automatic TM processing.
2008-01-27T12:38:32.000Z	142.5840	F	Automatic TM processing.
2008-01-28T22:28:43.000Z	142.5575	F	Automatic TM processing.
2008-01-30T12:27:12.000Z	142.5495	F	Automatic TM processing.
2008-01-31T16:16:51.000Z	142.5346	F	Automatic TM processing.
2008-02-02T12:16:16.000Z	142.5172	F	Automatic TM processing.
2008-02-03T21:51:15.000Z	142.4496	F	Automatic TM processing.
2008-02-05T12:07:51.000Z	142.4190	F	Automatic TM processing.
2008-02-06T21:38:28.000Z	142.4052	F	Automatic TM processing.

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, 02/02/2008 – 08/02/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 76 Open Loop Slews, 110 Closed Loop Slews and 5 Momentum Biases were executed.

1 slew (OSL) was missed from TL during the observation period, due to problems with the attitude reconstruction process on FDS (not enough stars for attitude reconstruction and consequent slew update).

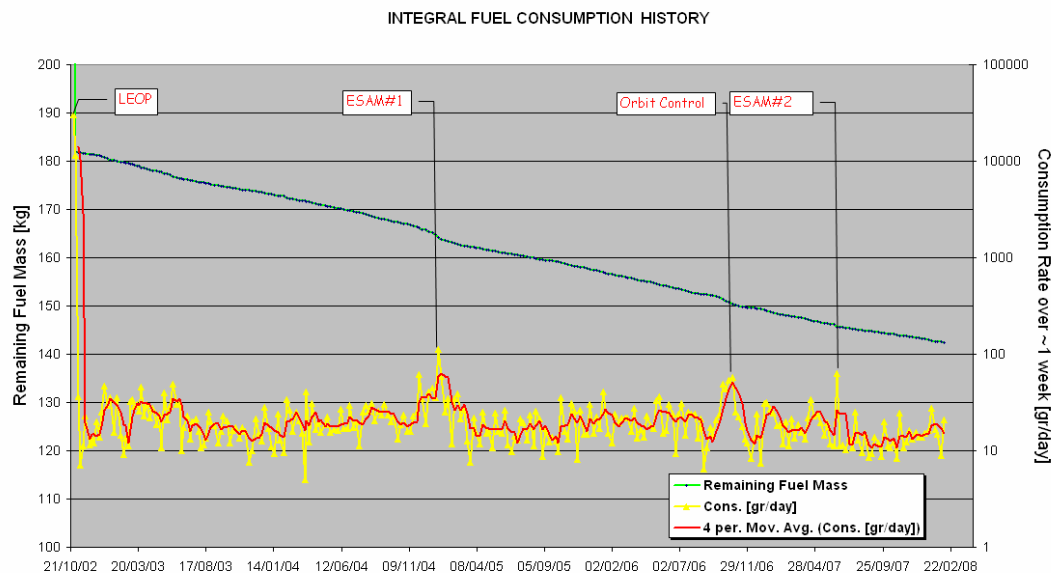
This is equivalent to $\sim 0.5\%$ of the total number of slews planned (186).

Orbit Control

No update.

Fuel consumption

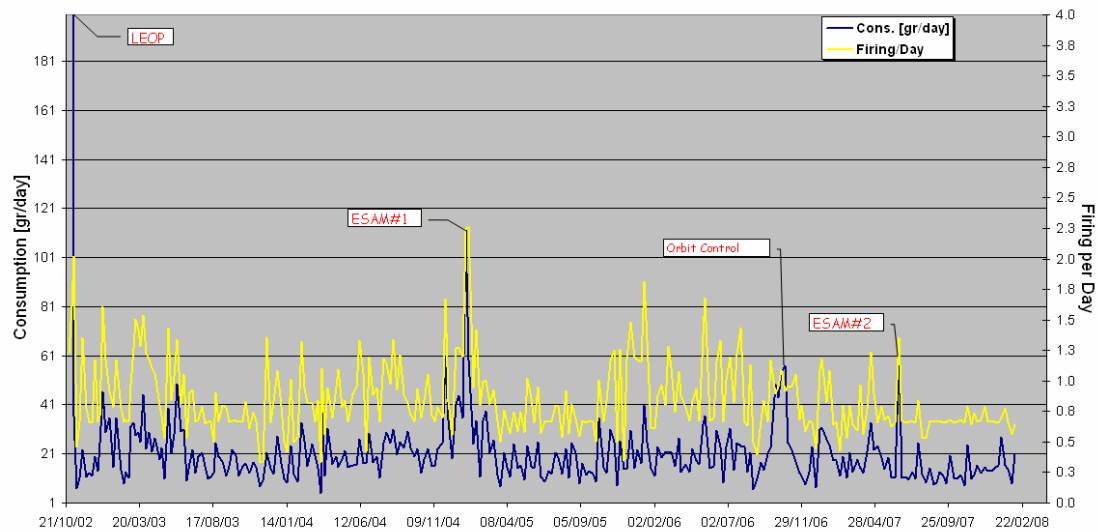
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 06/02/2008 is reported in the plot below.



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 06/02/2008 is reported in the plot below.

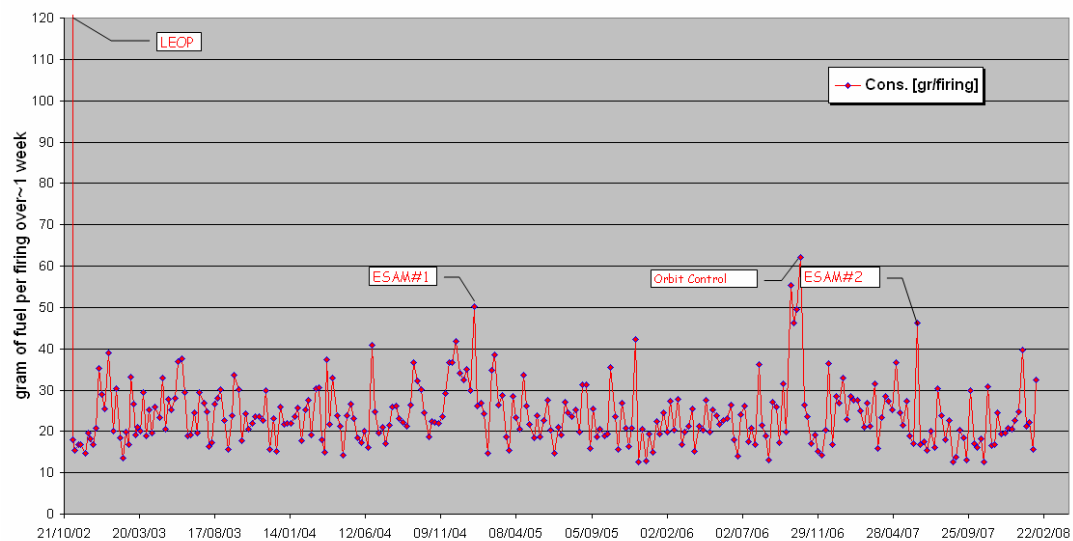
INTEGRAL FIRING PER DAY HISTORY



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

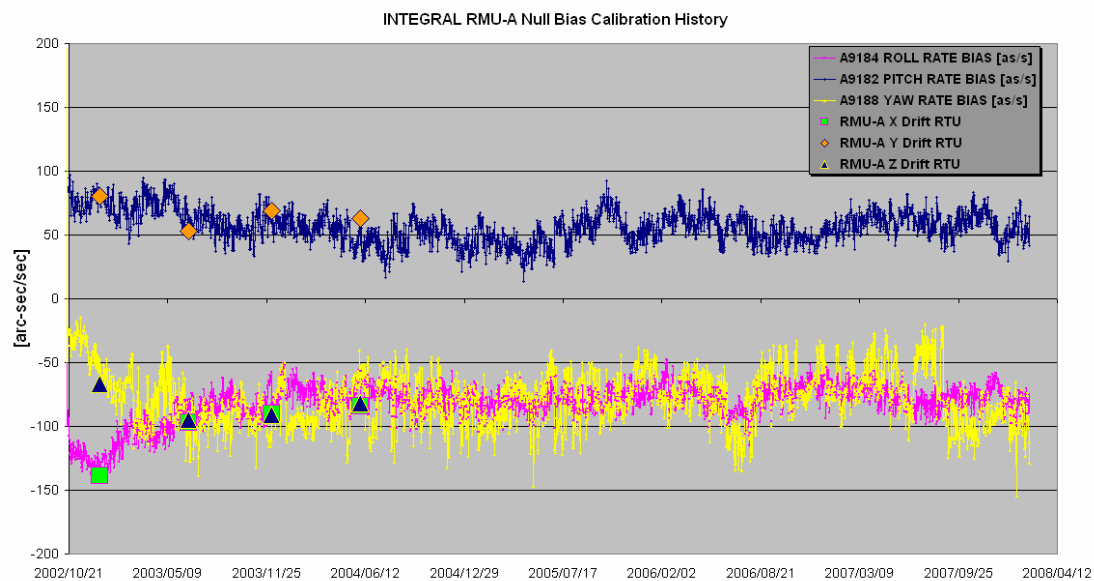
The fuel per firing over the period between 01/11/2002 and 06/02/2008 is reported in the plot below.

INTEGRAL FUEL MASS PER FIRING HISTORY



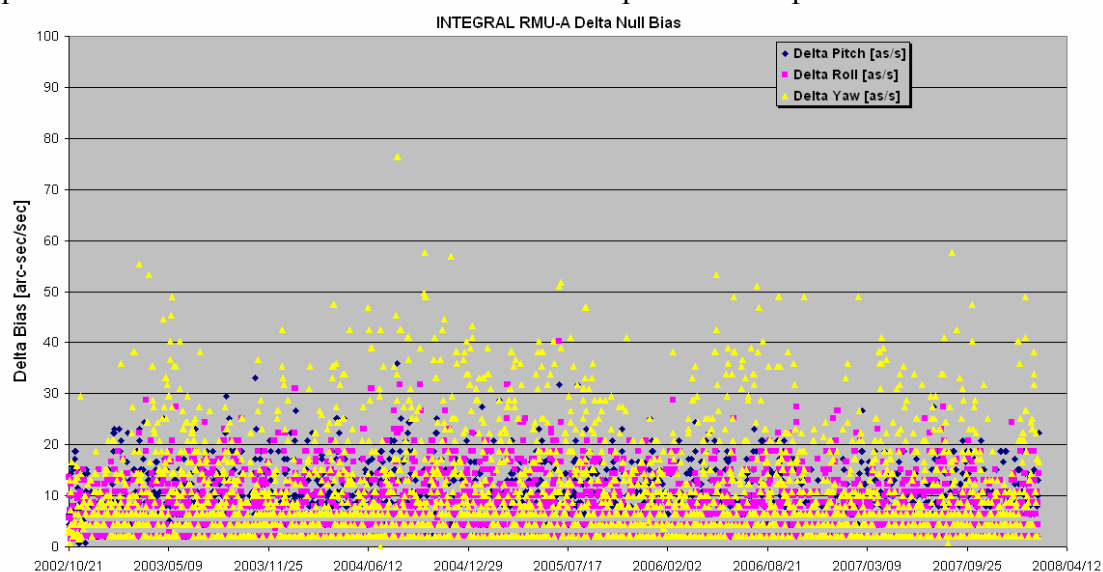
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 15/02/2008 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 15/02/2008 is reported in the plot below.



02/02/2008 (Day of Year 033, Revolution 647-648)

Search/Track star not found: at 07:43z the sequence for the last slew of rev 647 failed release due to problem during the Search/Track process (star not found).

At AOS for rev 648, the current guide star was checked by FD and a Change of Guide Star (CGS) manually generated before the starting of the Bias execution at the beginning of revolution.

No impact on TL

03/02/2008 (Day of Year 034, Revolution 648)

Problem on FDS: at 05:02z a problem on the attitude determination process on the FDS caused the update for slew ID 06480017 to fail. The number of valid stars in the STR FoV was below the requested threshold (≥ 3) and no slew update was generated.

A manual recovery was performed to the attitude of PID 06480017 and the slew ID 06480018 was updated at 06:09z. This was possible due to the more relaxed constraints applied to the manual recovery schedule tool wrt the automatic job schedule tool.

The following slew was missed in TL: 06480017(OSL)

04/02/2008 (Day of Year 035, Revolution 648)

Problem on FDS: at 22:39z a problem on the attitude determination process on the FDS caused the update for slew ID 06480082 to fail.

A manual recovery was performed and the slew ID 06480082 updated at 22:48z.

No impact on TL.

05/02/2008 (Day of Year 036, Revolution 648-649)

Nothing to report.

06/02/2008 (Day of Year 037, Revolution 649)

Nothing to report.

07/02/2008 (Day of Year 038, Revolution 649)

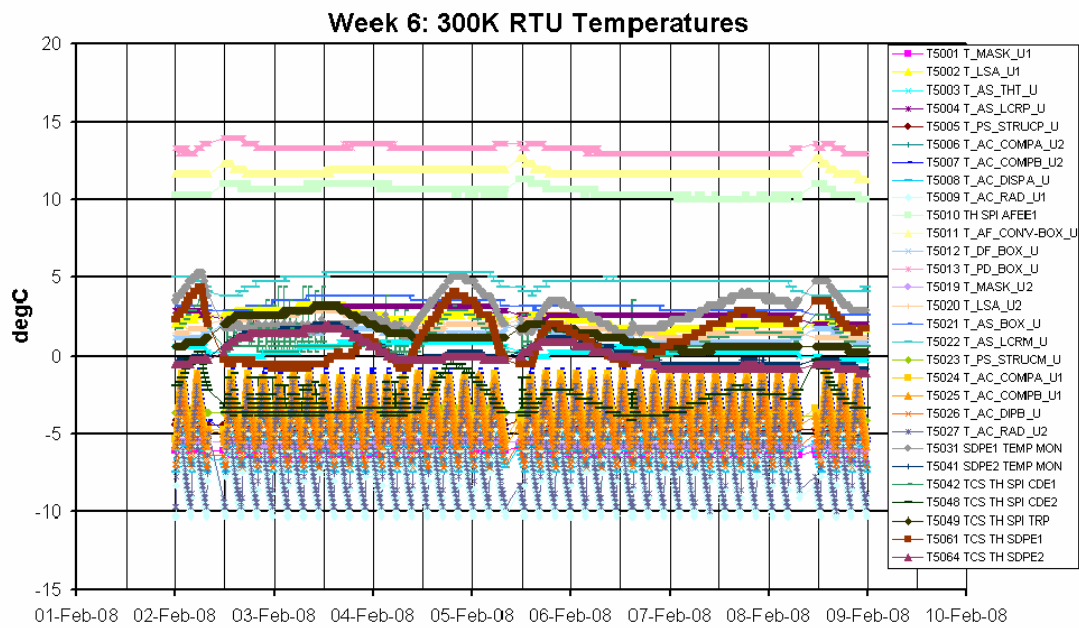
Nothing to report.

08/02/2008 (Day of Year 039, Revolution 649-650)

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.

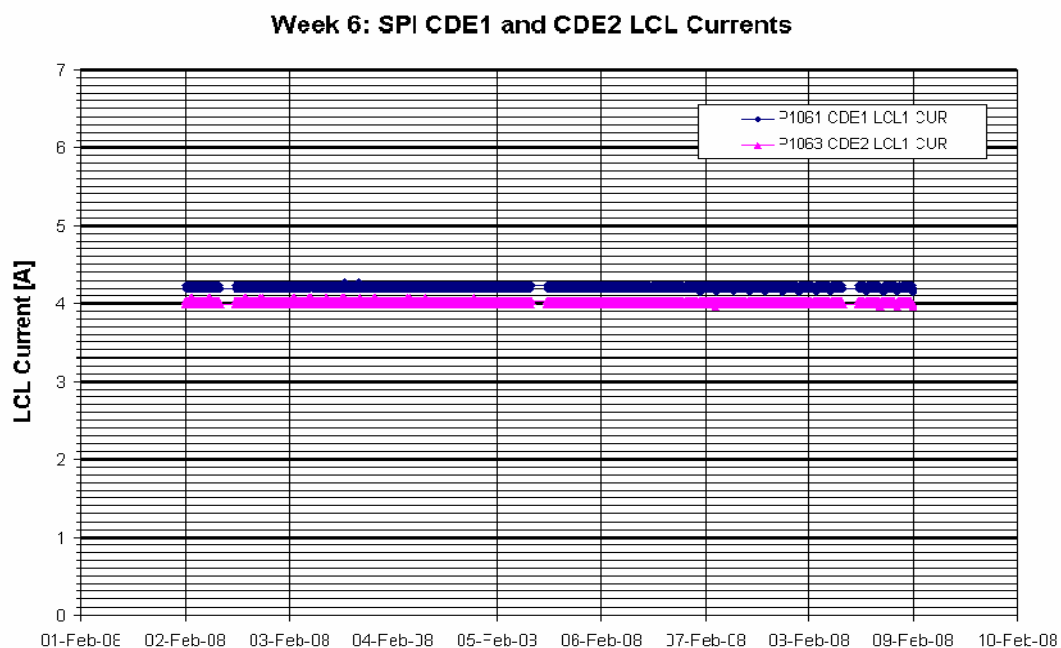


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K, with a positive drift of 0.166K/day.

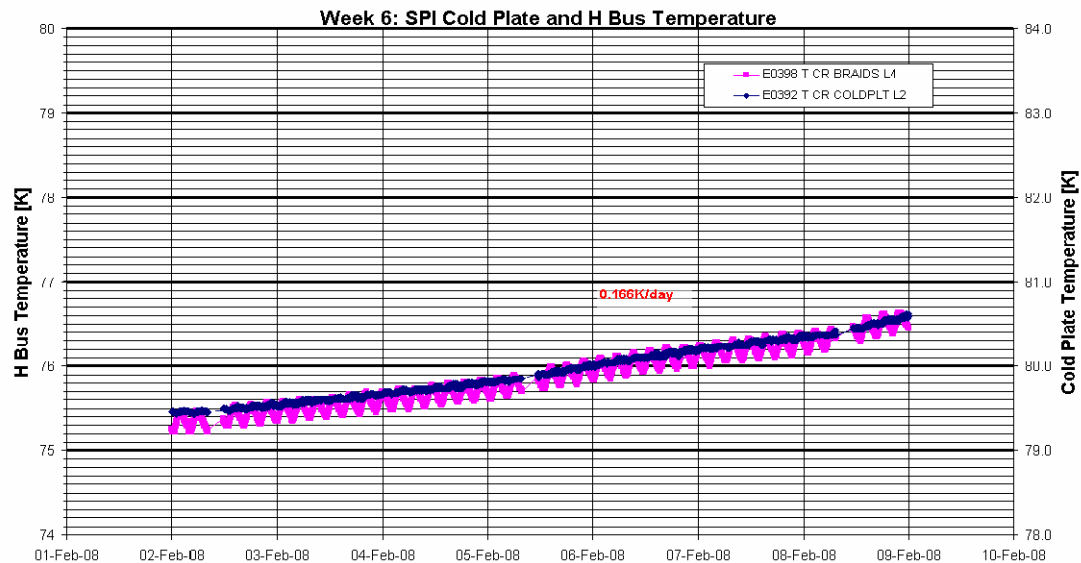
The stroke of all four compressors was set to 37 throughout the week. The average CDE LCL currents for the period were as follows:

- CDE1 LCL Current = 4.22A
- CDE2 LCL Current = 4.02A

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 bar temperatures during the reporting period.

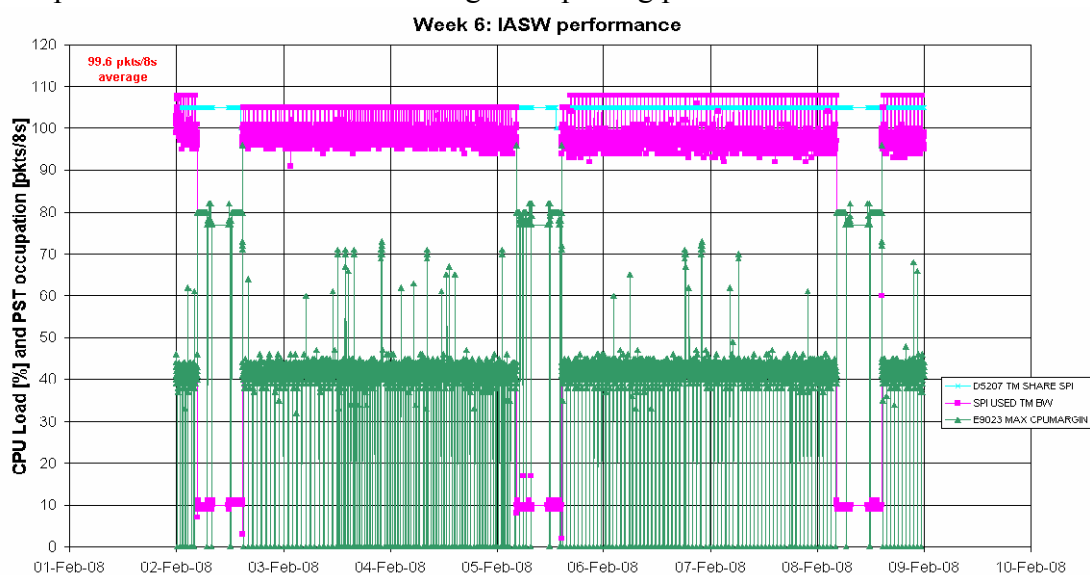


DPE & IASW: The DPE health and IASW performance is nominal.

The IASW version installed is v4.3.4 with ME reduction only enabled and the spectra scaling factor set to 8/19 SE.

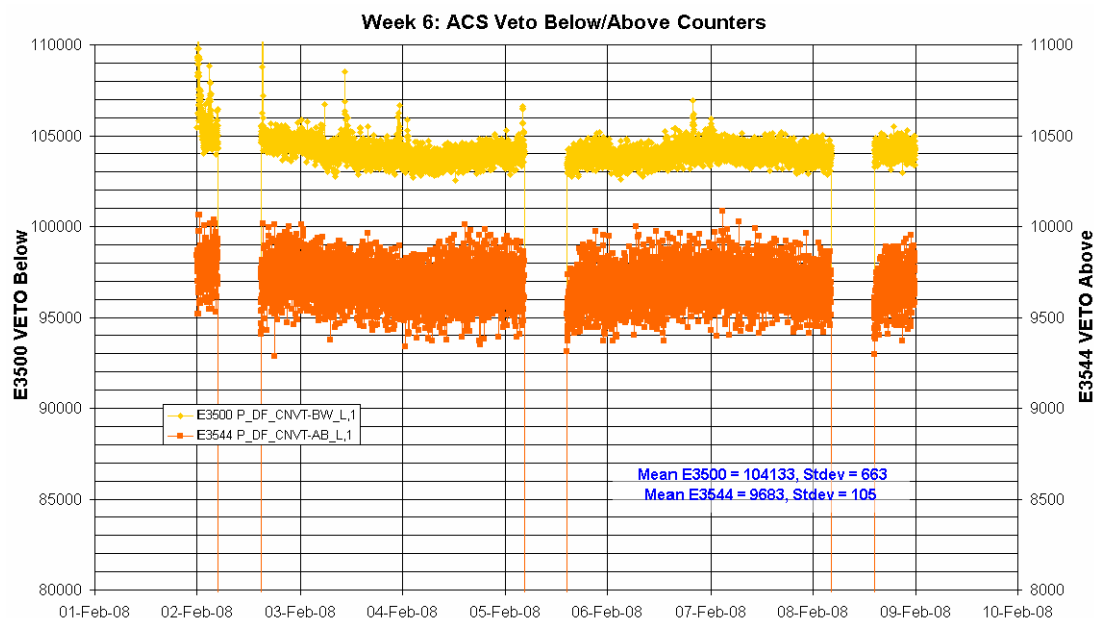
The average TM bandwidth occupation of SPI was 99.6 packets/cycle over the science window. The TM allocation in the science window was 105 packets/cycle, however in revolutions 647 and 649-650 the over-allocated PST with 108 packets/cycle for SPI was used. Note that the Broadcast Packet TM allocation was not updated. This did not cause any problems and SPI used the additional TM bandwidth during spectra transmission.

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

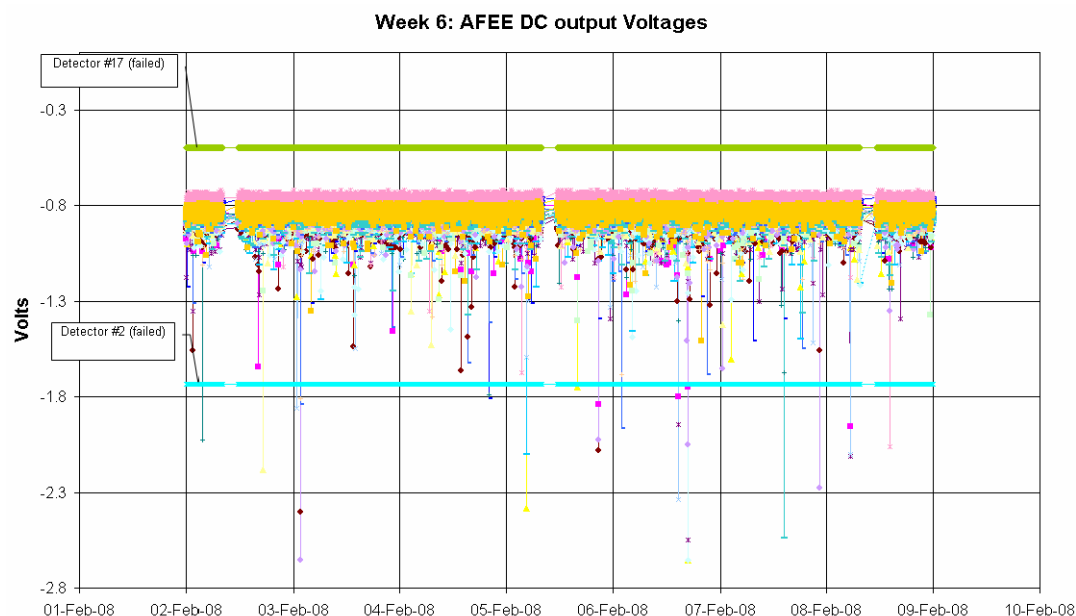


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

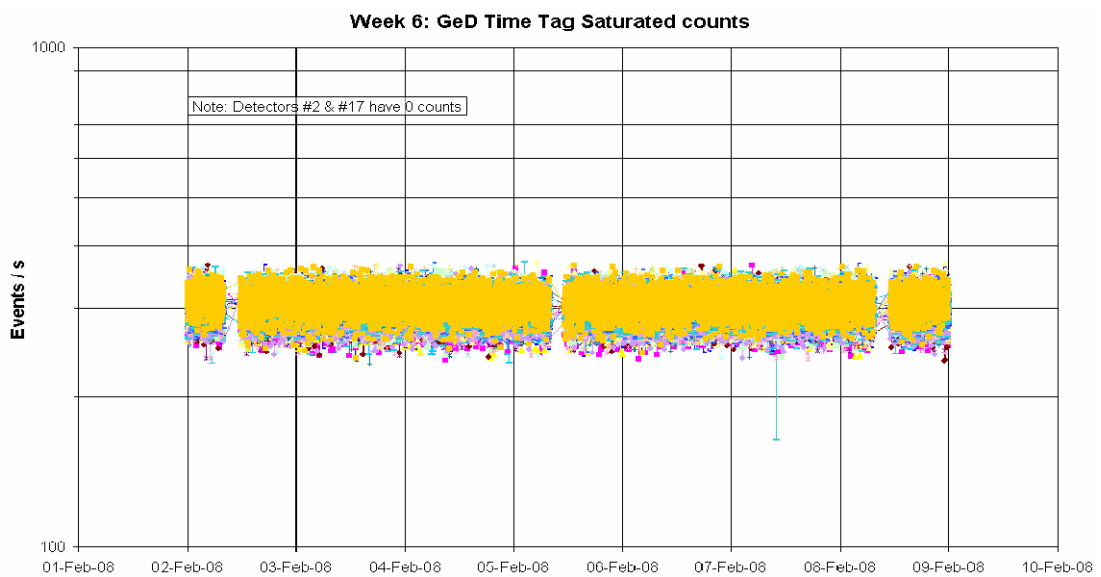
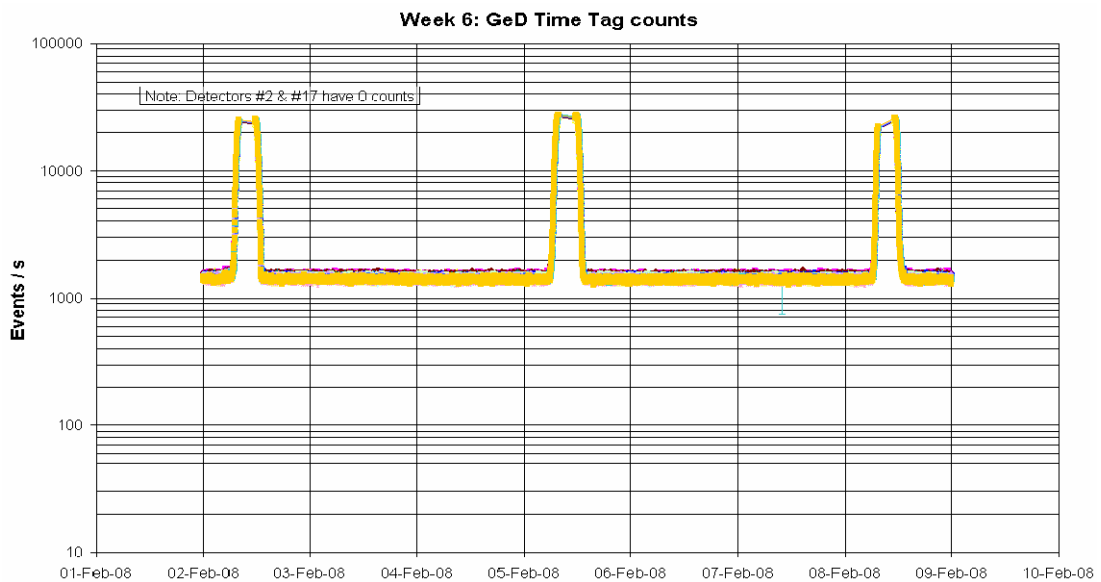
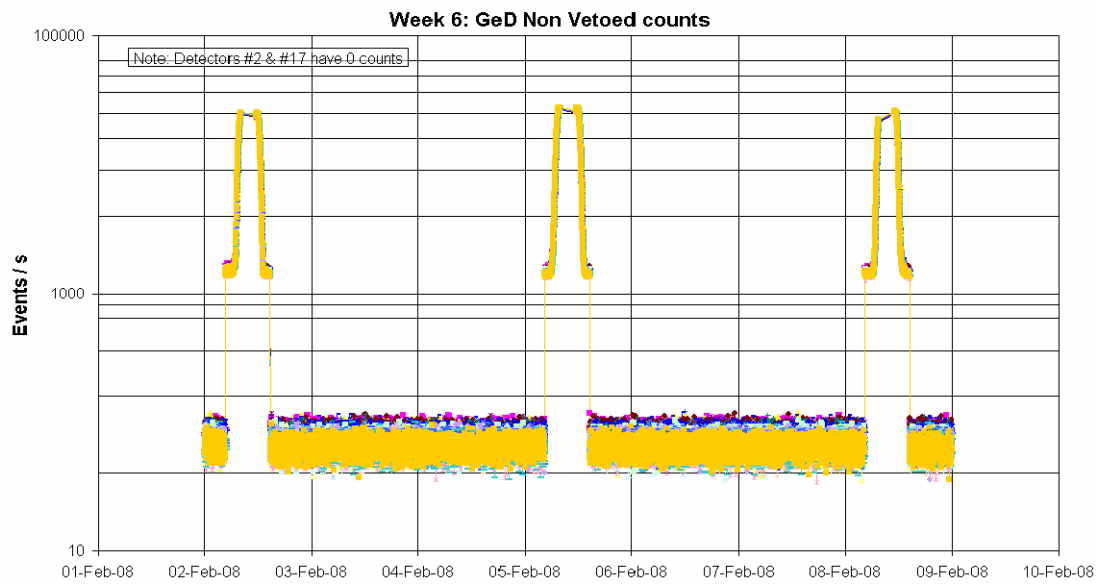
The following plot shows the ACS overall count rate evolution during the reporting period:



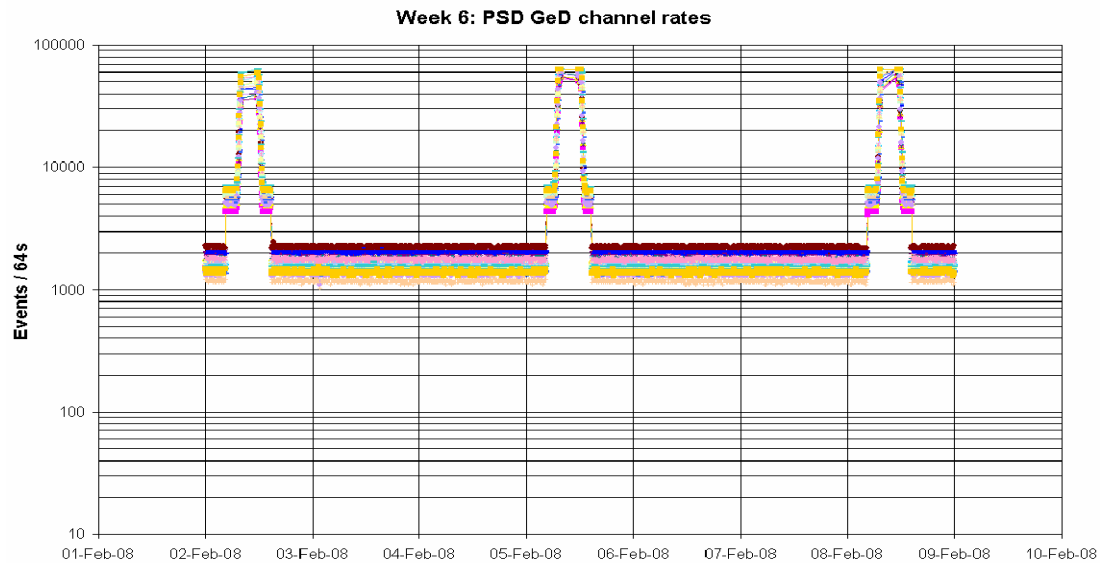
AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.



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



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



Event Log:

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

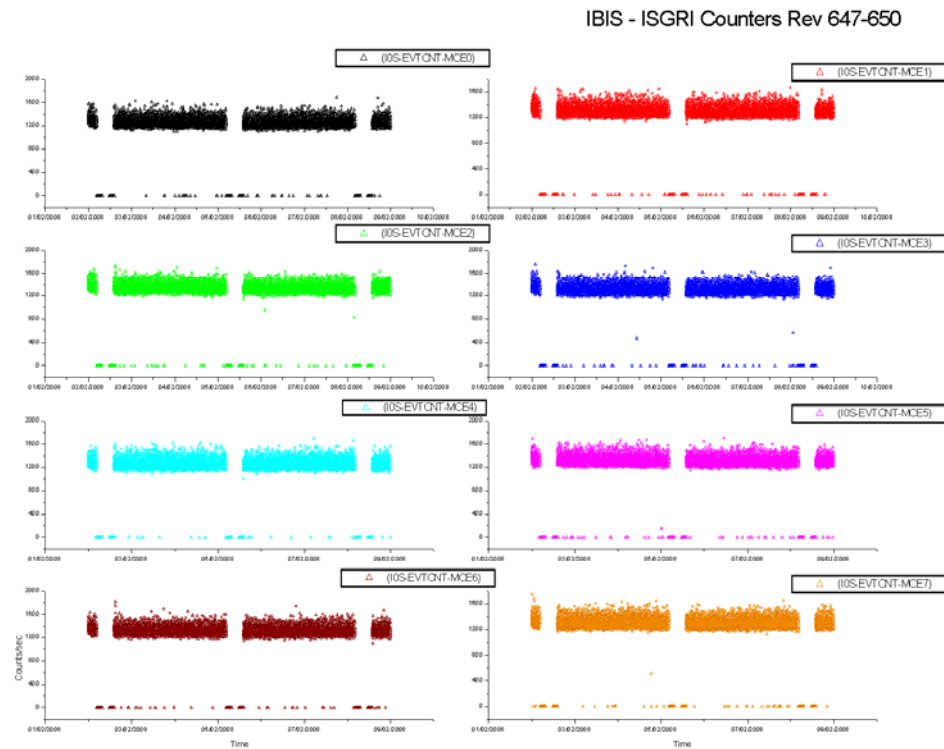
- On 2008-02-02 at 14:41:04Z, during the reconfiguration of SPI at radiation belt exit of revolution 648, TM parameters E2195-E2241; E2295-E2341; E2395-E2399; E3121-E3162; E3209- E3254 and E3289 went OOL (value = PARAM > SPEC). These are the ACS FEE digital status 5 V from FEE#45 onwards; ACS FEE analogue status 5 V from FEE#45 onwards; ACS FEE analogue status -5 V from FEE#45 onwards; ACS FEE temperature status from FEE#45 onwards and the PSAC Auxiliary Analogue Supply. They are in blocks 15, 16 and 17 of TM SPID 60601. The building of this packet started 74 seconds before the reconfiguration of the ACS at radiation belt exit and so the ACS parameters being zero was likely due to the acquisition of these blocks being exactly at the time the ACS switch-on was occurring. As they all returned within limits at 14:43:56Z no action was taken. This is a re-occurrence of Anomaly Report INT_SC-211, which has been updated accordingly.
- On 2008-02-03 at 15:22:37Z and 15:22:44Z OEM APID 1024 ID 229 EXCEPTION SPI1 PARTIAL FLAG OVERFLOW were received (with E9783 = SP15 in the first occurrence and E9783 = SP13 in the second occurrence). This indicates that the DFEE could not send all the SE data within those 125 ms cycles. As these were the only occurrences, no action was taken.
- On 2008-02-05 at 11:46:18Z, during the AOS_CHK window of revolution 649, TM parameter E4009 S DF HSLERR L went OOL (value = 1), indicating erroneous HSL transfers. As it returned within limits at the next TM cycle, no action was taken.
- On 2008-02-08 at 11:35:58Z OEM APID 1024 ID 1 EXCEPTION SPI1 FIXED POINT OVERFLOW was received. This was during the AOS_CHK window of revolution 650, 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

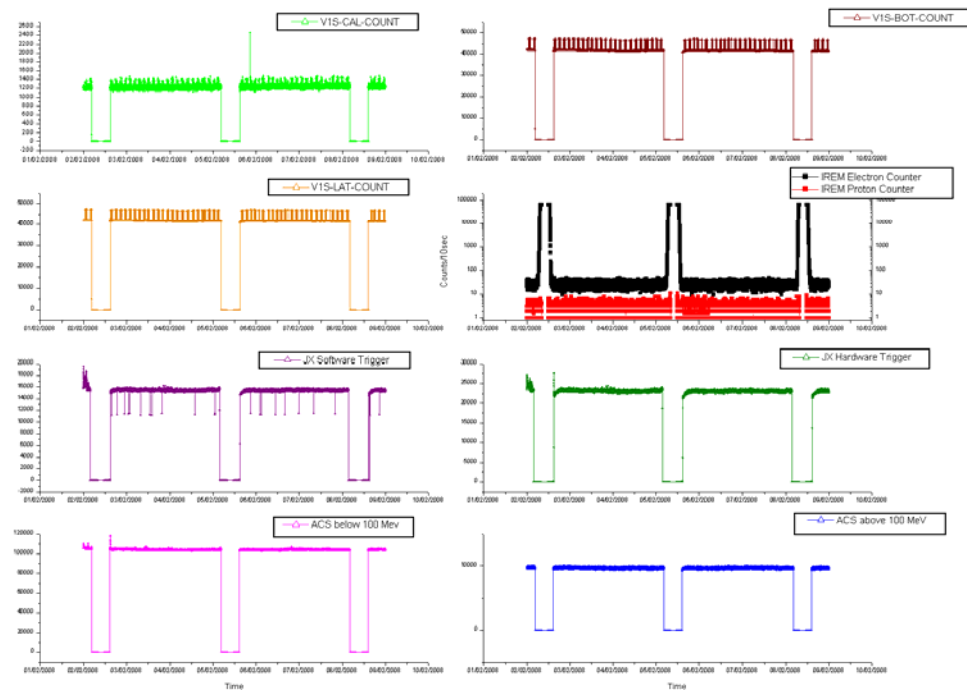
IBIS Event Counters Plots

ISGRI Counters:



VETO vs Payload Counters:

IBIS-VETO vs Payloads Counters Rev 647-650

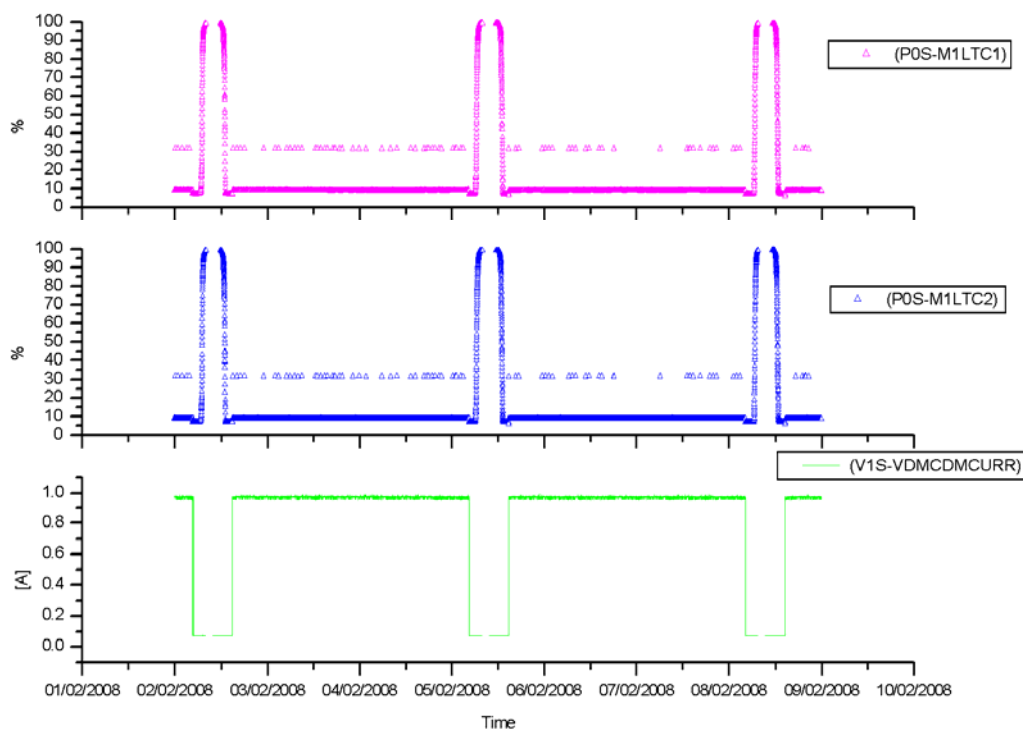


**with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec sampling every 5 pkts (40 sec)

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

VETO Current:

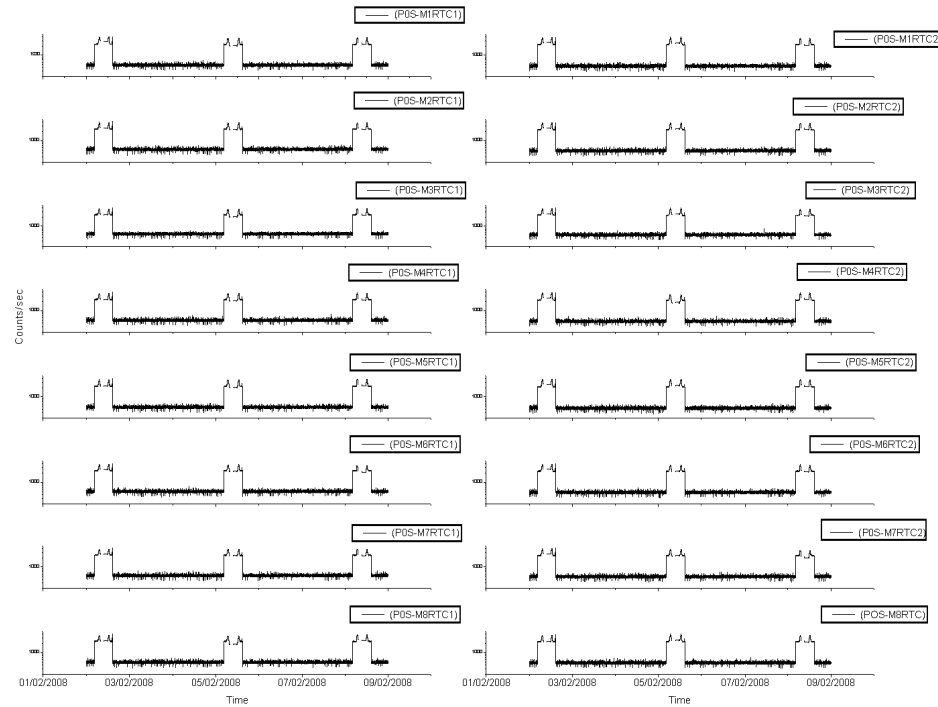
IBIS-VETO Current & PICsIT dead times Rev 647-650



**sampling every 4 pkts (32 secs)

PICsIT Counters:

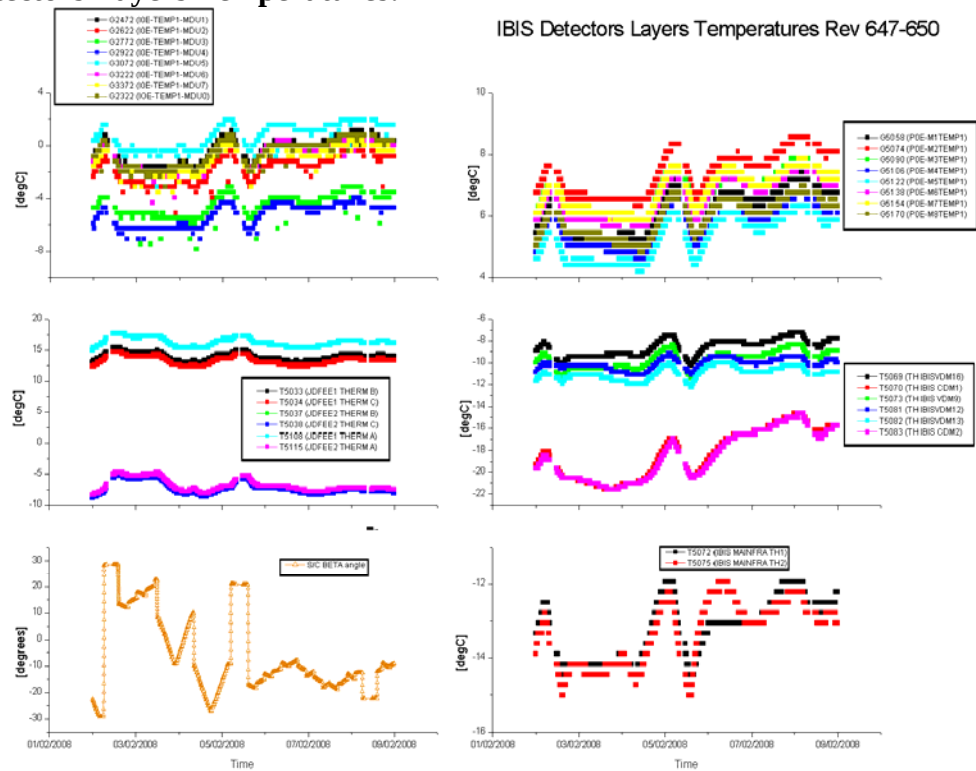
IBIS - PICsIT Counters Rev 647-650



**sampling every 4 pkts (32 secs)

IBIS Detectors Layers Temperatures:

IBIS Detectors Layers Temperatures Rev 647-650



**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.

2008-02-02 (DOY 033, Rev 647-648) to 2008-02-04 (DOY 035, Rev 648)

IBIS operations executed nominally.

2008-02-05 (DOY 036, Rev 648-649)

As can be seen from the plot of the VETO counters above, a spike in the VETO Calibration counter (TM parameter G6061) occurred at 20:30:26Z, with the value going to 2468 counts/s, the nominal value being approximately 1200 counts/s. At the next TM cycle, G6061 returned to a nominal value of 1256 counts/s and no further spikes were observed. All other VETO parameters were nominal before, during and after this spike and therefore no action was taken.

2008-02-06 (DOY 037, Rev 649) to 2008-02-08 (DOY 039, Rev 649-650)

IBIS operations executed nominally.

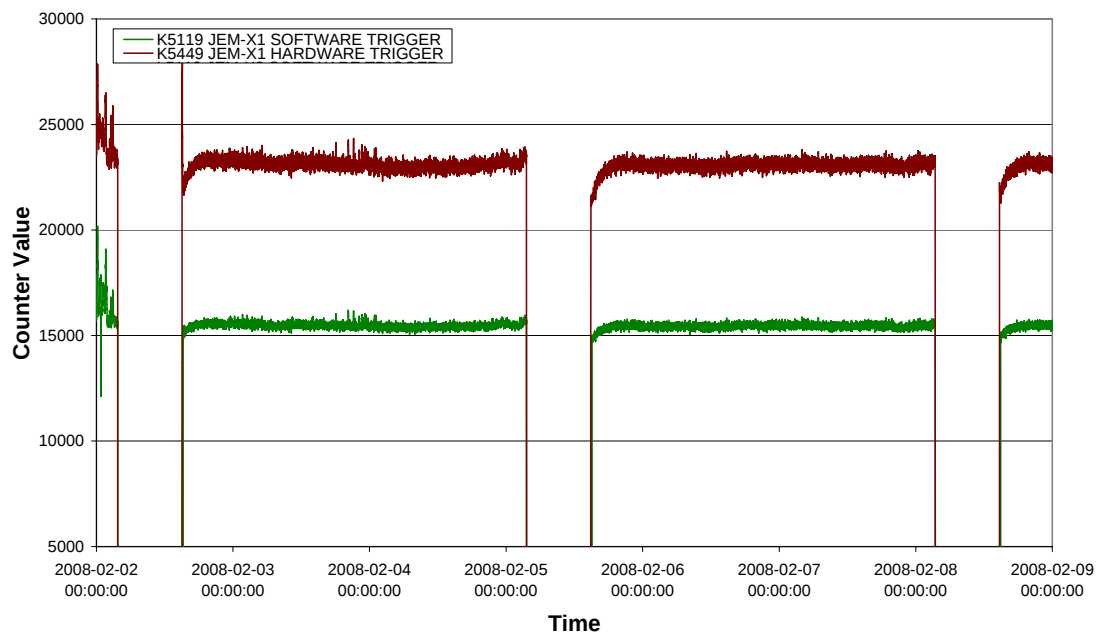
8.3.4 JEM-X Operations

JEM-X Count Rates

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

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

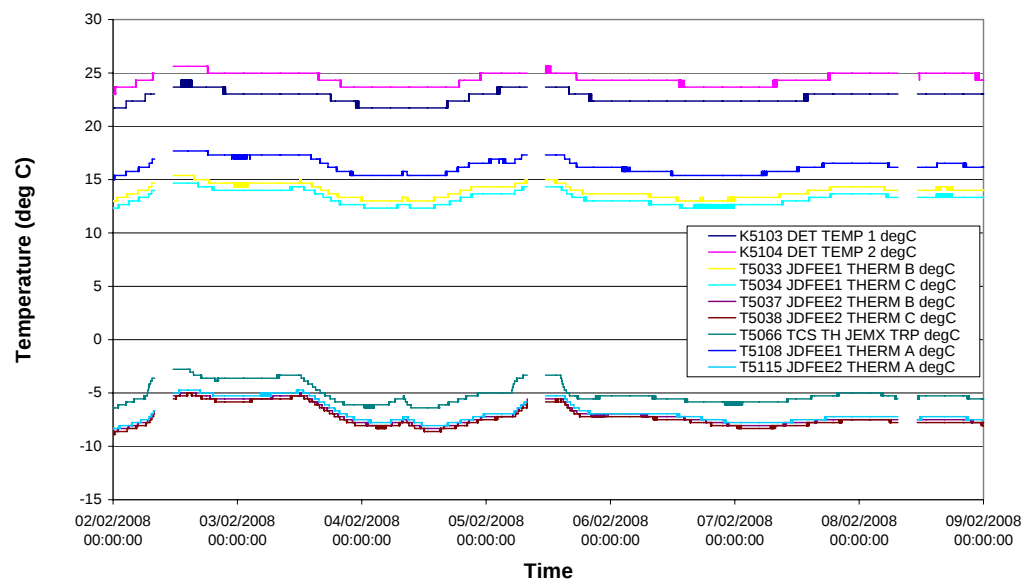
JEM-X Count Rates



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.

JEMX Detector & DFEE Temperatures



JEM-X Daily Report

2008-02-02 (DoY 033, Rev 647-648) to 2008-02-08 (DoY 039, Rev 649-650)

² Data sampled (1 frame in 8)

JEM-X1 operations executed nominally

8.3.5 OMC Operations

2008-02-02 (DoY 033, Rev 647-648) to 2008-02-08 (DoY 039, Rev 649-650)

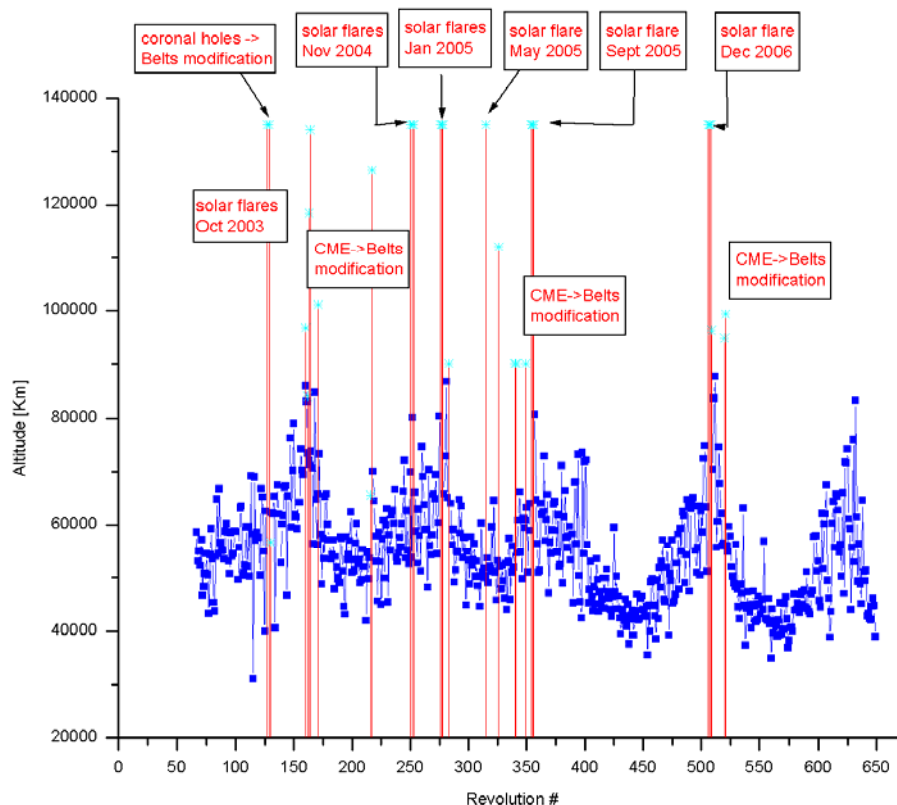
Nothing to Report.

On DoY 033 at 04:40:04, DoY 036 at 04:30:05 and DoY 039 at 04:18:37 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]
647	RAD_ENTR R 2008-02-02T04:39:57Z	02/02/2008 05:52:11	46084.9	02-Feb-2008 06:09:30	43014

648	RAD_EXIT R 2008-02-02T14:41:48Z	02/02/2008 13:49:55	>>33282.1	02-Feb-2008 13:39:30	44161.91
648	RAD_ENTR R 2008-02-05T04:30:04Z	05/02/2008 05:48:43	44721.8	05-Feb-2008 05:58:59	43067.95
649	RAD_EXIT R 2008-02-05T14:31:46Z	05/02/2008 13:29:15	43172.3	05-Feb-2008 13:28:59	44130.29
649	RAD_ENTR R 2008-02-08T04:18:34Z	08/02/2008 06:17:08	38842.3	08-Feb-2008 05:48:59	42900.7
650	RAD_EXIT R 2008-02-08T14:20:52Z	08/02/2008 13:18:20	>>31609.4	08-Feb-2008 13:18:59	44235.61

Reference

High radiation

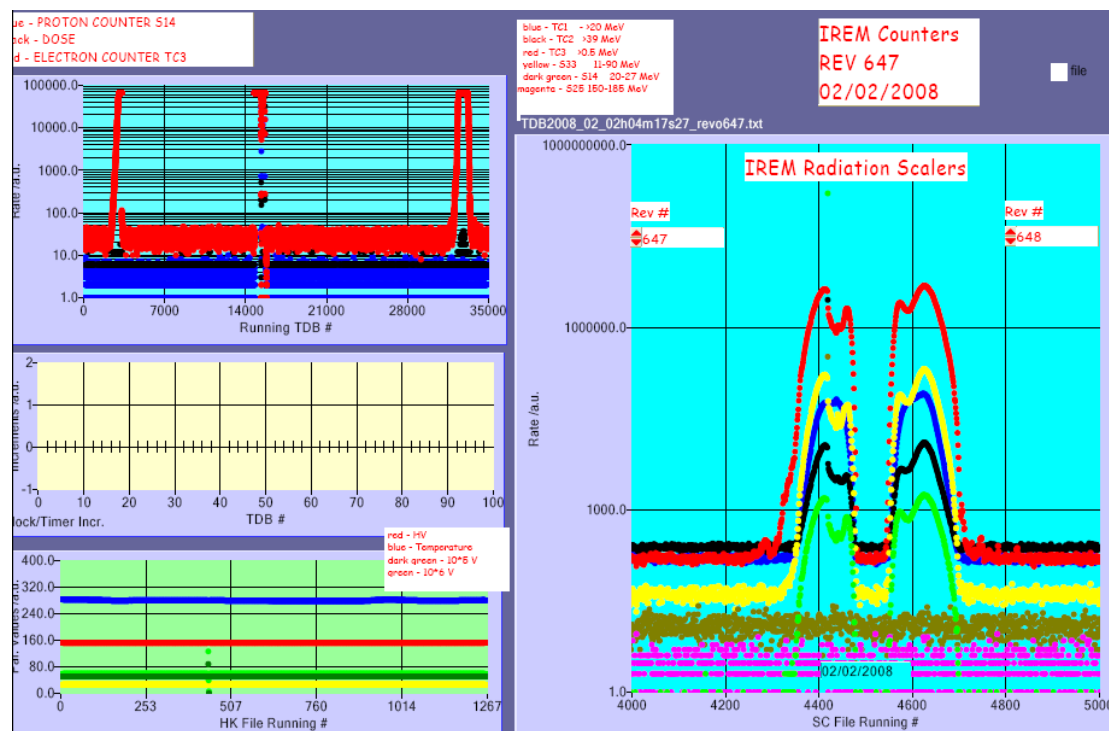
Very small error vs reference (less than 10 minutes)

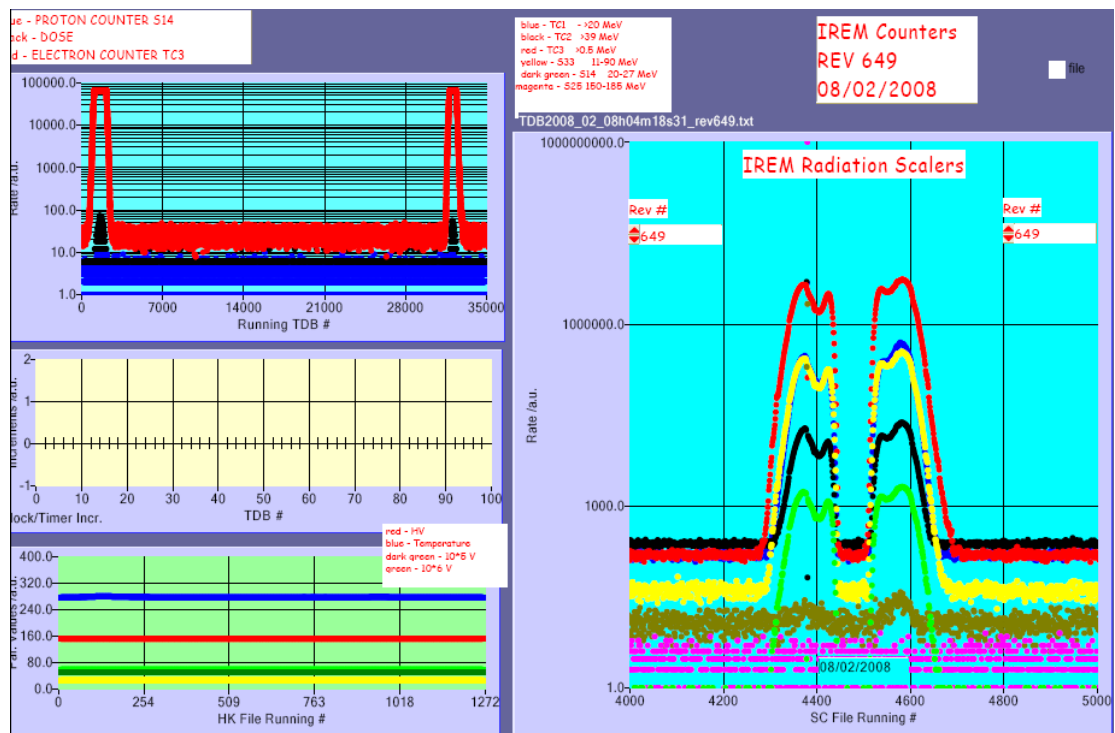
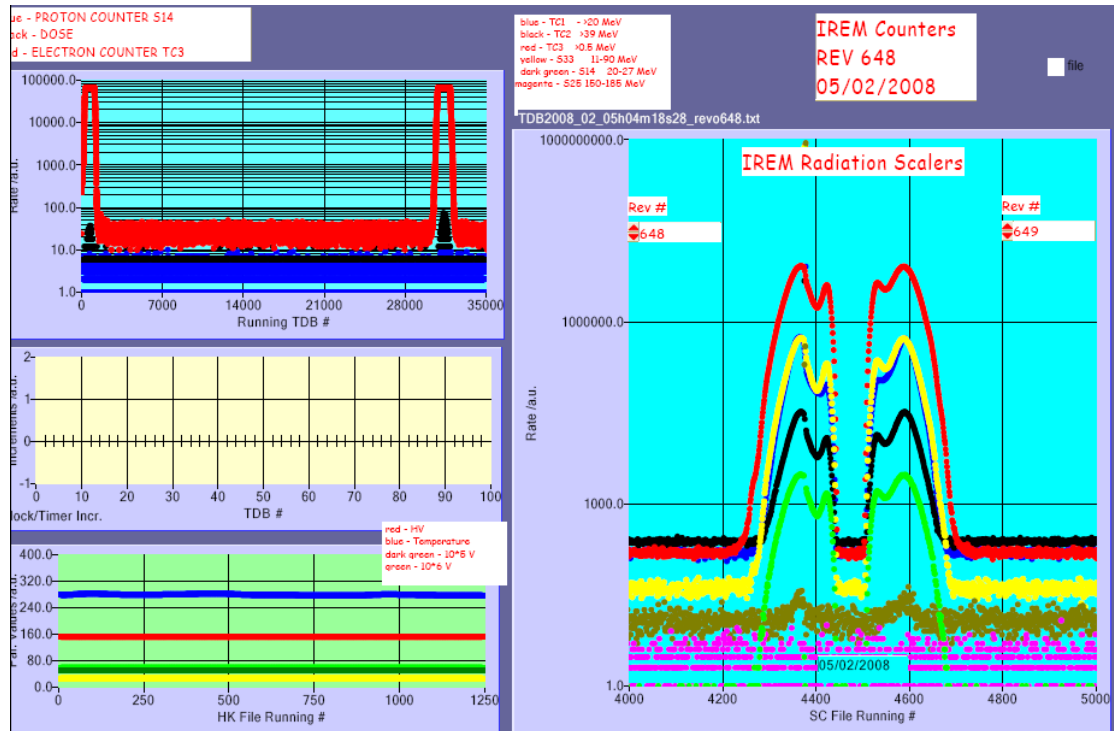
Small error vs reference (between 10 and 30 minutes)

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.

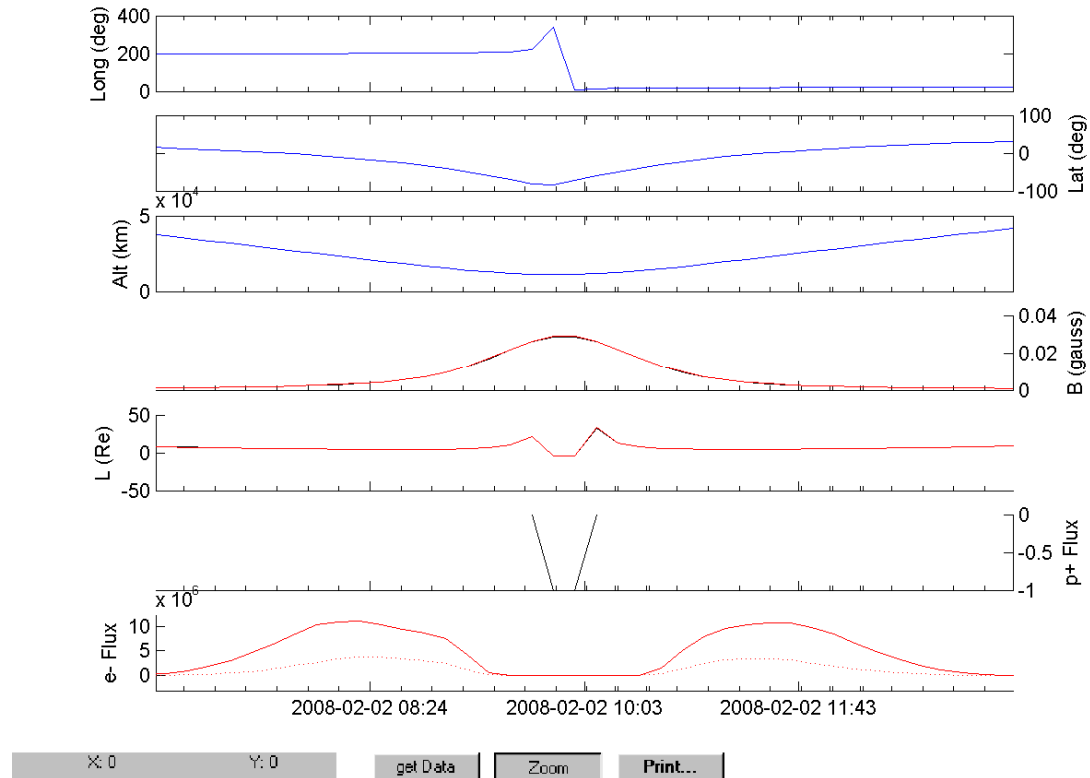
IREM radiation counters:



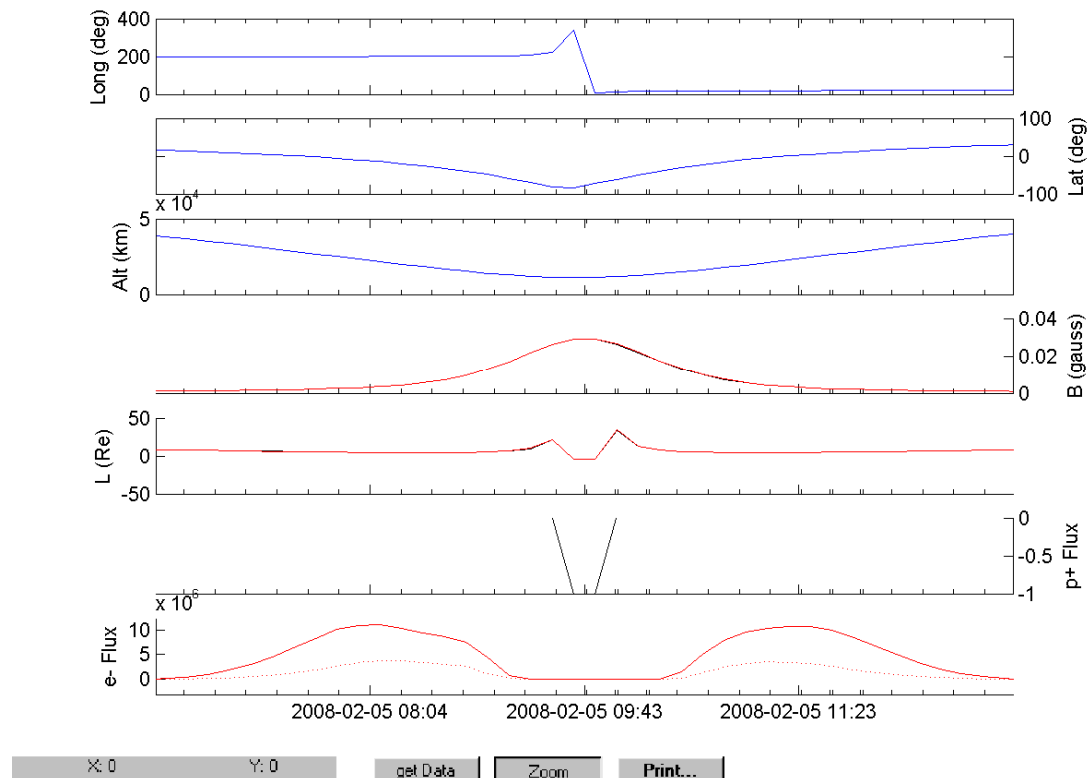


IREM Predicted Radiation Belt Passages

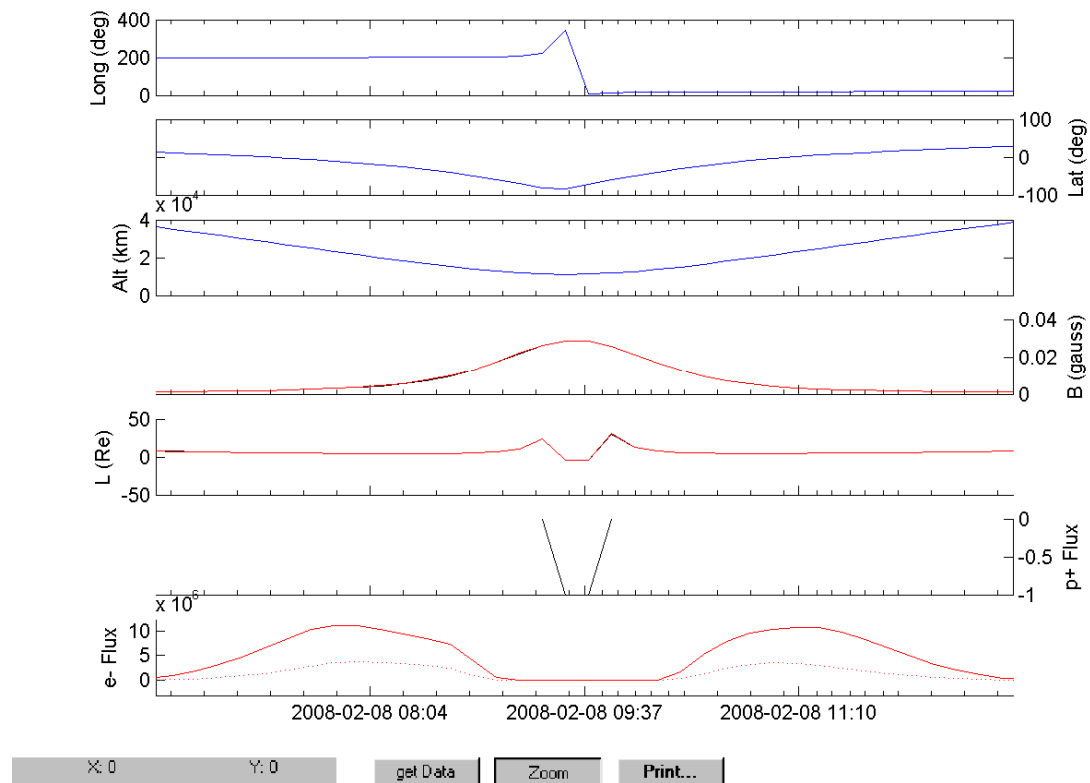
Rev 647



Rev 648



Rev 649



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.