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

INTEGRAL
Mission Report

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

No. 304
Week 29

21.07.08

Routine Phase

Prepared by: M.J.H. Walker (OPS-OAI) and INTEGRAL FCT

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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 12.07.08 until 18.07.08 (both dates inclusive) and covers the revolutions 702 and 703.

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 raster dithers of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), an OMC Flat Field calibration, (RA 14:33:36.00, DEC -16:24:00.0), a sequence of Galactic disk latitude scans (twice each) (RA 14:00:52.80, DEC -59:42:00.0), (RA 14:13:14.40, DEC -63:25:48.0), (RA 14:32:36.00, DEC -58:18:00.0), (RA 14:28:36.00, DEC -62:48:36.0).

Note: Some further information concerning the activities is provided in the Appendix.

3 Satellite Status

3.1 Platform

The performance of the platform was good. No new unexpected behaviour / malfunction was identified.

3.1.1 AOCS

The AOCS operations were performed from the timeline during this period.

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

The fuel consumption over the period between 12/07/2008 and 17/07/2008 was 0.0918 Kg. The remaining propellant is in the order of 139.6300 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.

From the EPS point of view the eclipse passage was entirely nominal.

3.1.3 Thermal

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

3.1.4 OBDH

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

The PST was over-subscribed by 3 packets, which were allocated to SPI during the Instrument window for the entire reporting period.

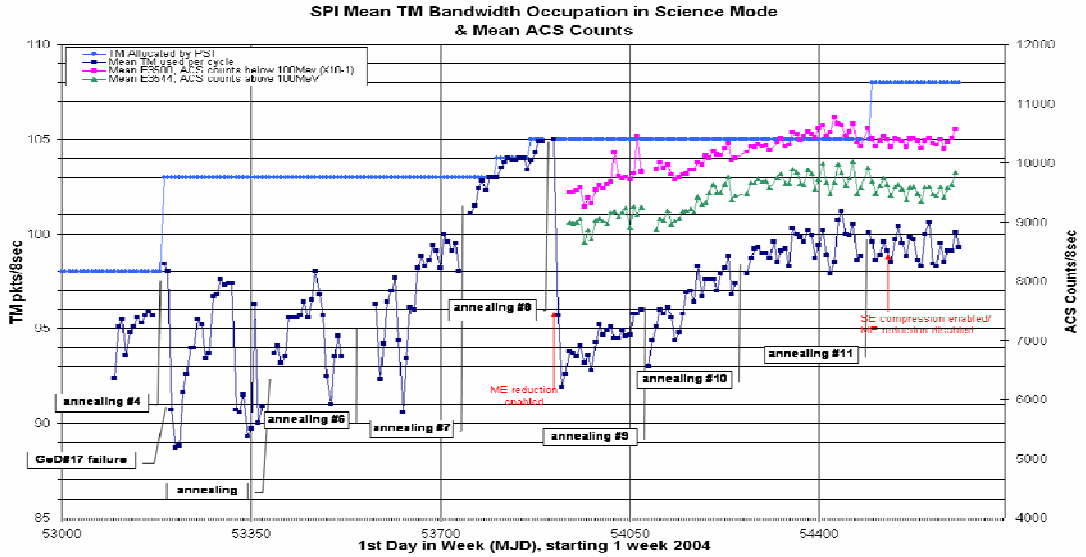
3.1.5 RFS

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

3.2 Payload

3.2.1 SPI

Following the 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 108 packets/cycle, except from 2008-07-13T21:59:06Z to 2008-07-14T01:46:42Z, when it was 85 packets/cycle due to an OMC Flat Field Calibration. The average telemetry occupation in the science window when the allocation was 108 packets/cycle was 99.3 packets/cycle.
The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth along with the mean ACS count rate evolution (since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



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

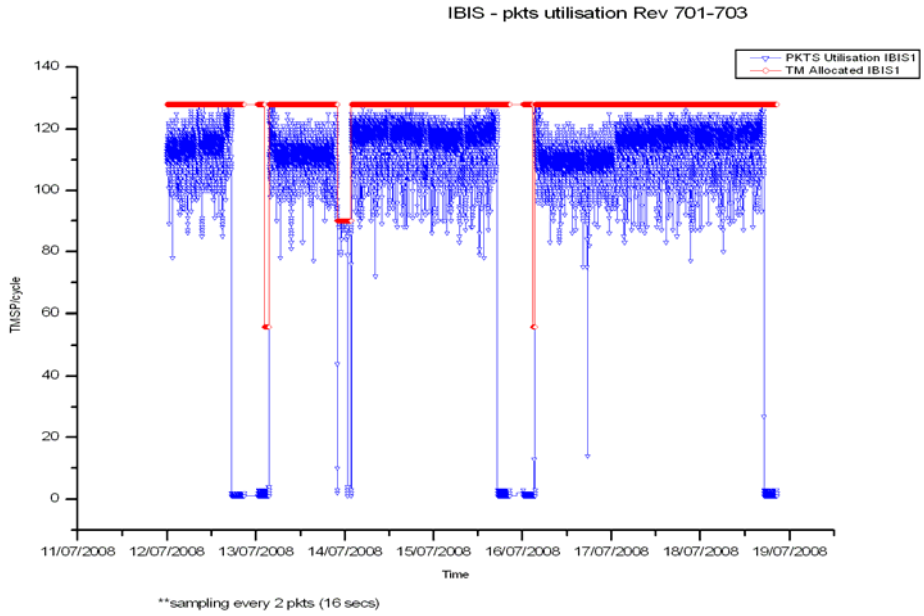
3.2.2 IBIS

The overall status of the unit is nominal.

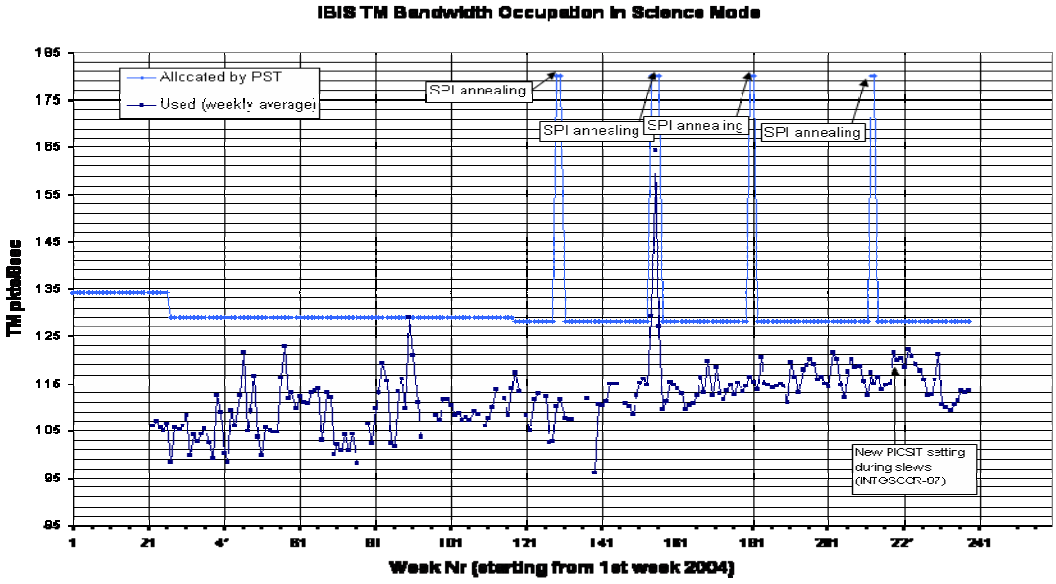
During the reporting period, the TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 128 packets/cycle except from 2008-07-13T21:59:06Z to 2008-07-14T01:46:42Z, when it was 90 packets/cycle due to an OMC Flat Field Calibration.
- IBIS mean bandwidth utilisation in science mode: 113.44 packets/cycle (up 0.40 on last week)
- Percentage of TM cycles in which full bandwidth was used: 0.61%

The plot below shows the IBIS TM utilisation during the observation period.



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



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

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

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

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

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, except from 2008-07-13T21:59:06Z to 2008-07-14T01:46:42Z, during the Flat Field Calibration, when it was 63 packets/cycle.

During this reporting period, all of the 180 planned science pointings 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 until the 18th, when a new sun spot (#1000) began to emerge. The risk of solar flares was very low.

Reference: www.spaceweather.com

Note: Some more information concerning the IREM operations is provided in the Appendix Section 8.3.6.

4 Ground Facilities

The Operational ground facilities performance was excellent this week. The overall performance was nearly 100%.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. There was a FD problem with one pointing, which was manually executed without impact.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There was one drop of TM from Redu, and two from DSS-27, one of which was due to bad weather, and two drops in the link with ISDC. No pointings were lost to network problems.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 712 and 713
Observations have been planned for revolutions 708 to 711.

New TSFs have been received for revolutions 703 to 706.

2. Observation status

New ECS files were received for revolutions 688 and 690 to 693. The ECS for 689 is still missing.

3. ISOC Science Data Archive

No news.

4. ISOC system

ISOC system V19.3 has been installed on 15 July.

5. Problems

None.

4.3.2 ISDC

Status of ISDC observation processing on 21/07/2008:

- Latest Standard Analysis completed: observation 05200260004 (mid-latitude 2, Revolutions 680 & 681) on 26/06/2008.

- Latest products archived: observation 05200260004 (mid-latitude 2, Revolutions 680-681) on 26/06/2008.

- Latest observation products sent to the observer: observation 05200510009 (Mrk 421, Revolutions 679) on 16/06/2008.

5 Special Events

6 Anomalies

The following problem was reported this week that impacted operations.

- On DoY 190 at 02:00, the TM from Redu dropped, the cause was given as a hit on the line. The Timeline was suspended, and a recovery performed. Normal service was resumed at 02:35. The impact was the loss of pointing 07000025.

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

AR id	Date Created	Subject	Segment	Status
INT-3011	2008-07-15	FDS failed slew update	FDS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 702

The observations in revolution 702 began with a raster dither of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), lasting ~17.4 hours. They continued with an OMC Flat Field calibration #27, a staring observation at attitude (RA 14:33:36.00, DEC -16:24:00.0), lasting ~3.4 hours. Finally a sequence of Galactic disk latitude scans (RA 14:00:52.80, DEC -59:42:00.0), lasting ~8.8 hours, then (RA 14:13:14.40, DEC -63:25:48.0), lasting ~8.8 hours, then back to (RA 14:00:52.80, DEC -59:42:00.0), lasting ~8.3 hours, then back to (RA 14:13:14.40, DEC -63:25:48.0), lasting ~8.3 hours, was performed until the end of the revolution.

Revolution 703

The observations in revolution 703 began with a raster dither of Loop I-Loop IV Super (RA 13:57:10.00, DEC +07:34:37.0), lasting ~21.3 hours. They continued with a sequence of Galactic disk latitude scans (RA 14:32:36.00, DEC -58:18:00.0), lasting ~8.8 hours, then (RA 14:28:36.00, DEC -62:48:36.0), lasting ~8.8 hours, then back to (RA 14:32:36.00, DEC -58:18:00.0), lasting ~8.3 hours, then back to (RA 14:28:36.00, DEC -62:48:36.0), lasting ~8.3 hours, was performed until the end of the revolution.

Throughout these observations, all instruments were in their nominal science modes, except JEM-X2, which is switched off. The TM allocation was IBIS 128; SPI 108; JEM-X1 8; JEM-X2 0; OMC 5, except from 2008-07-13T21:59:06Z to 2008-07-14T01:46:42Z, during the OMC Flat-Field calibration when it was IBIS 90; SPI 85; JEM-X1 8; JEM-X2 0; OMC 63.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

```
2008-06-26T11:59:22.000Z     139.9435    F   Automatic TM processing.
2008-06-28T02:07:42.000Z     139.9309    F   Automatic TM processing.
2008-06-29T11:44:25.000Z     139.9025    F   Automatic TM processing.
2008-07-01T01:54:53.000Z     139.8979    F   Automatic TM processing.
2008-07-02T11:14:18.000Z     139.8716    F   Automatic TM processing.
2008-07-04T01:39:26.000Z     139.8576    F   Automatic TM processing.
2008-07-05T11:01:53.000Z     139.8229    F   Automatic TM processing.
2008-07-07T01:27:57.000Z     139.8135    F   Automatic TM processing.
2008-07-08T10:47:05.000Z     139.7851    F   Automatic TM processing.
2008-07-10T01:16:53.000Z     139.7750    F   Automatic TM processing.
2008-07-11T10:51:12.000Z     139.7218    F   Automatic TM processing.
2008-07-13T01:06:44.000Z     139.7195    F   Automatic TM processing.
2008-07-14T11:21:12.000Z     139.6937    F   Automatic TM processing.
2008-07-16T00:57:24.000Z     139.6844    F   Automatic TM processing.
2008-07-17T10:20:16.000Z     139.6300    F   Automatic TM processing.

This report was generated  Fri Jul 18 08:00:26 GMT 2008
```

8.3 Detailed Satellite Information

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

8.3.1 AOCS SUMMARY OPERATIONS REPORT, 12/07/2008 – 18/07/2008

The AOCS operations were executed from the Automatic Timeline.

During this period, 86 Open Loop Slews, 115 Closed Loop Slews and 4 Momentum Biases were executed (as reported by ACC).

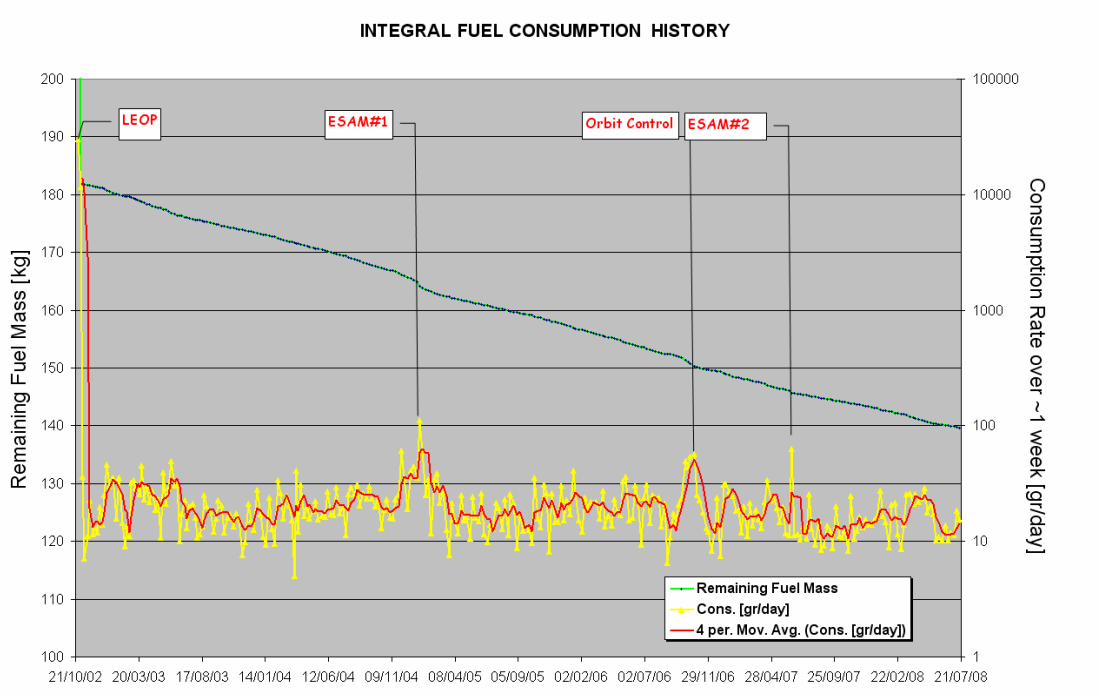
No slews were missed from TL, during the observation period.

Orbit Control

No update

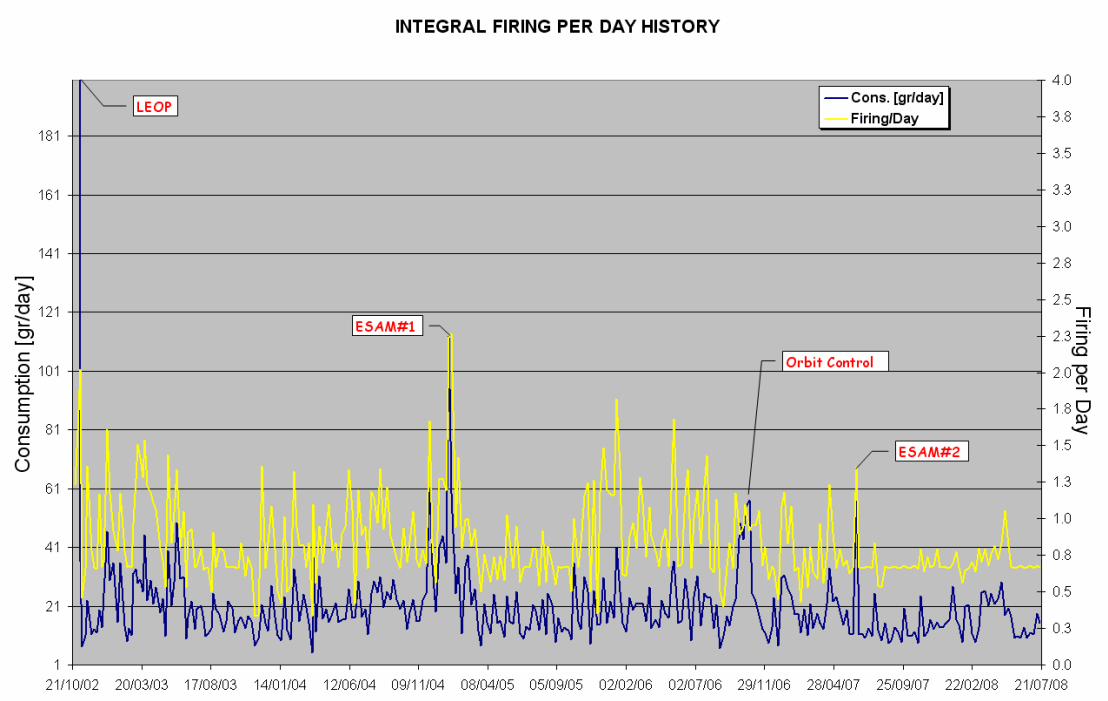
Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 17/07/2008 is reported in the plot below.



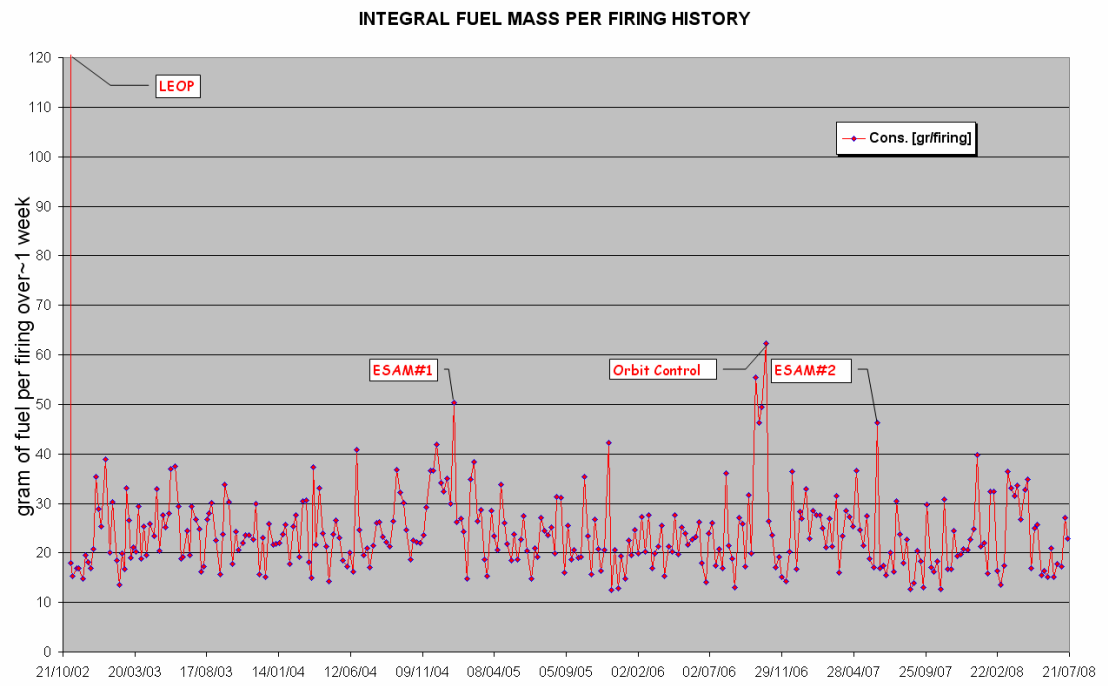
The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The firing per day over the period between 01/11/2002 and 17/07/2008 is reported in the plot below.



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

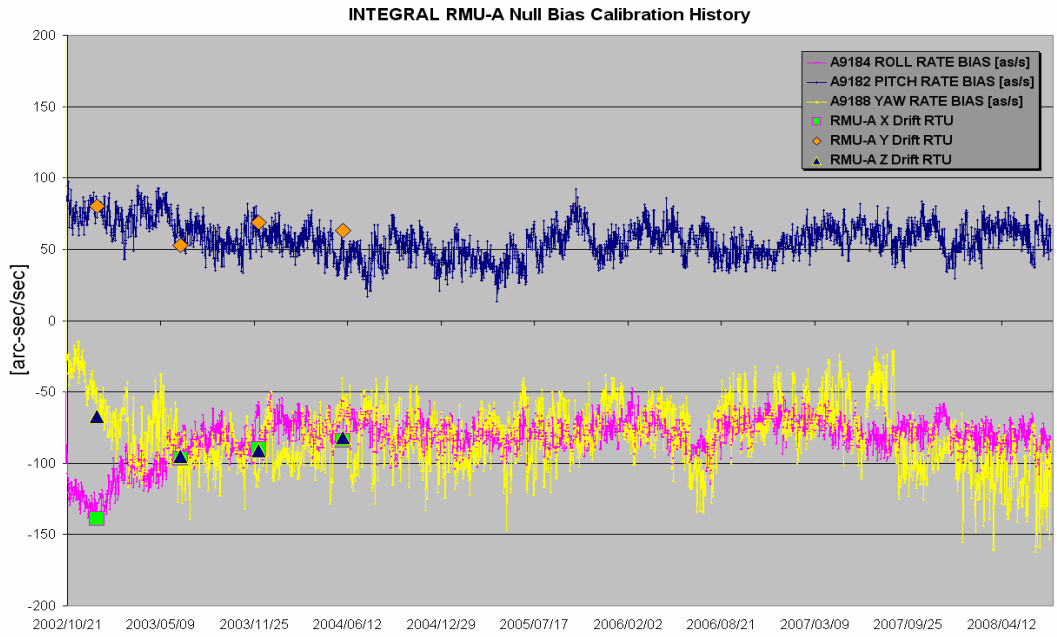
The fuel per firing over the period between 01/11/2002 and 17/07/2008 is shown in the plot below.



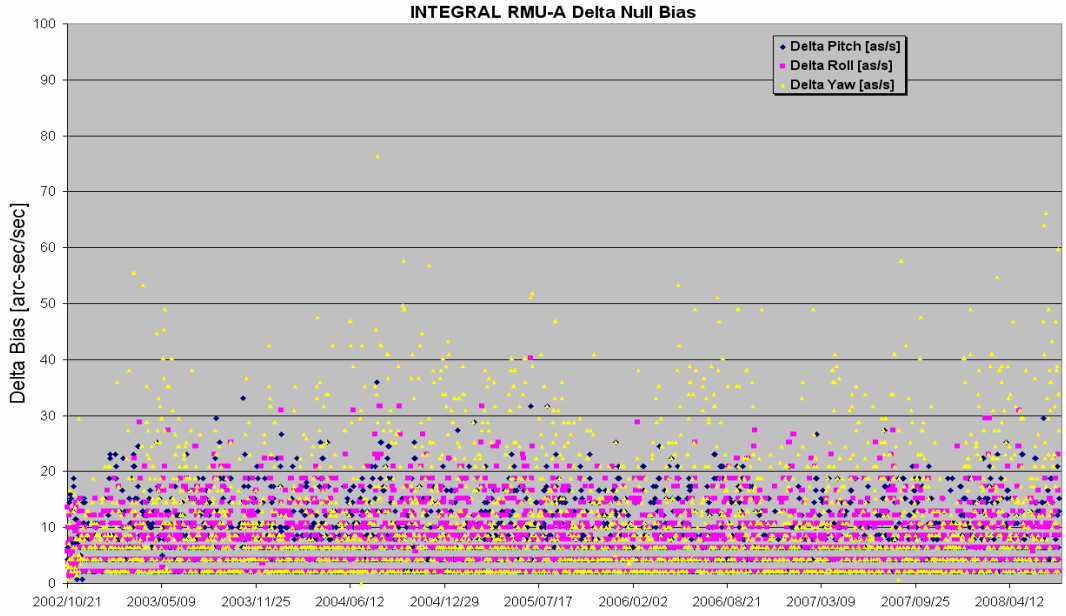
The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 25/07/2008 is reported in the plot below.
Problems have been reported during the last period on FDS when generating the drift update for the RMU-A Yaw channel: the limits set on FDS have been violated few times. The evolution of the drift on yaw channel is under constant monitoring but the

values are still well within the specs. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over period between 01/11/2002 and 25/07/2008 is reported in the plot below.



12/07/2008 (Day of Year 194, Revolution 701)

Nothing to report.

13/07/2008 (Day of Year 195, Revolution 701-702)

Nothing to report.

14/07/2008 (Day of Year 196, Revolution 702)

Nothing to report.

15/07/2008 (Day of Year 197, Revolution 702)

FDS failed slew update: at 08:23z the FDS failed the update of slew ID 07020077. FDS reported an error during the update process: the following manoeuvre could not be executed due to wheel speeds violation.

A manual recovery was performed by FD on-call at 08:37z and the slew ID 07020077 was manually updated in TL.

No impact on TL.

16/07/2008 (Day of Year 198, Revolution 702-703)

Nothing to report.

17/07/2008 (Day of Year 199, Revolution 703)

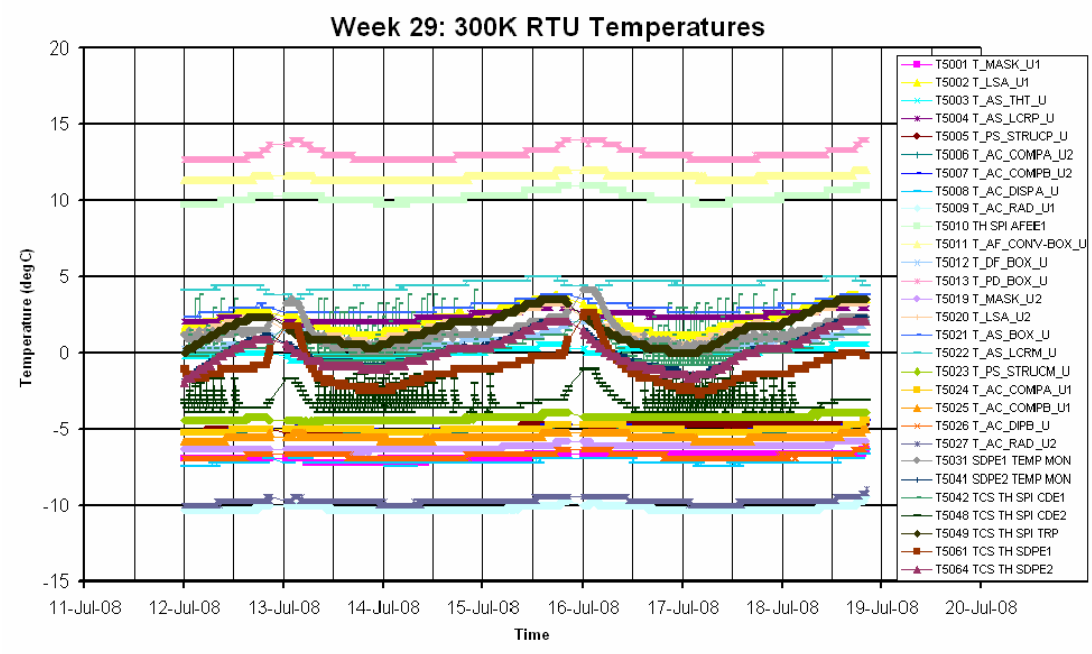
Nothing to report.

18/07/2008 (Day of Year 200, Revolution 703)

Nothing to report.

8.3.2 SPI Operations

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

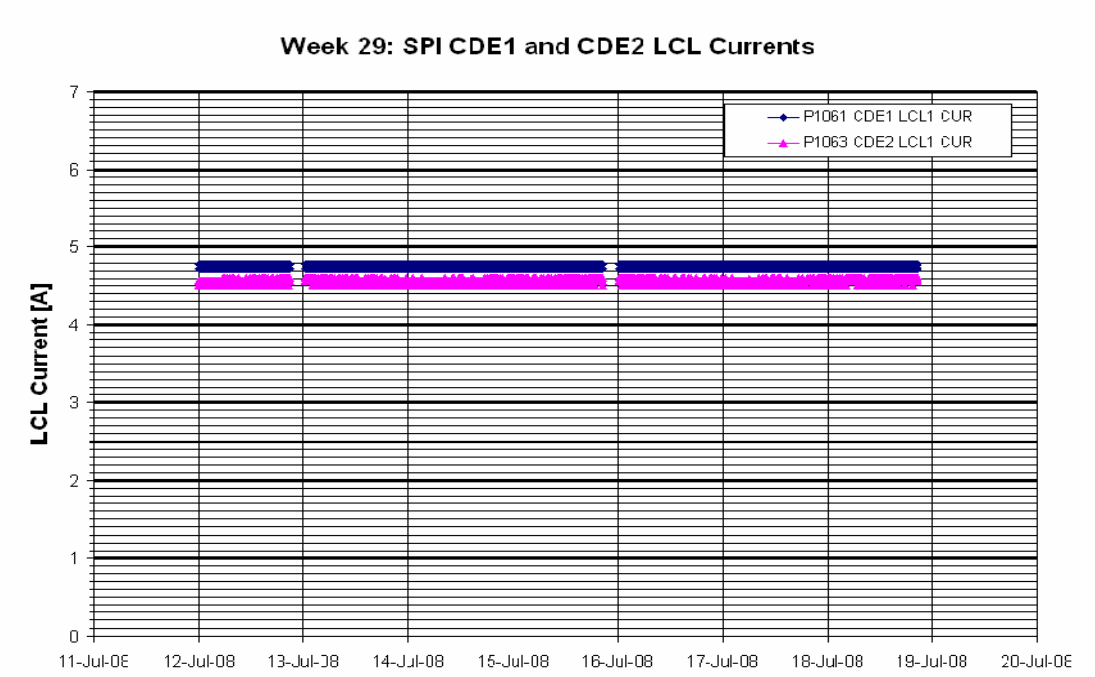


Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

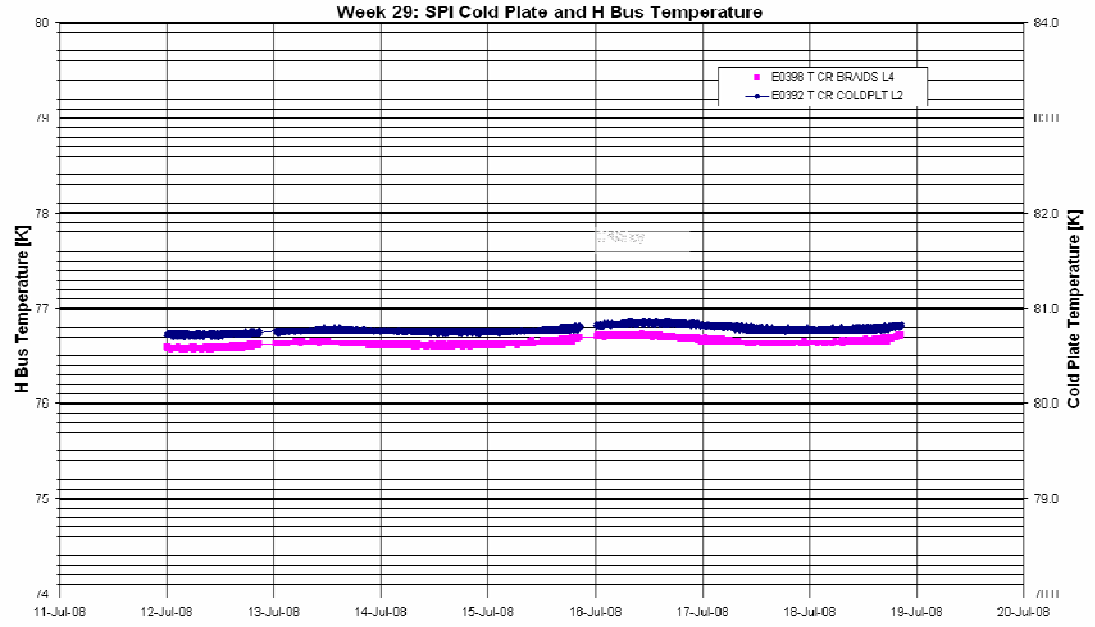
The stroke of all four compressors was set to 40 throughout the week. The average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.75A
- CDE2 LCL Current = 4.56A

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



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

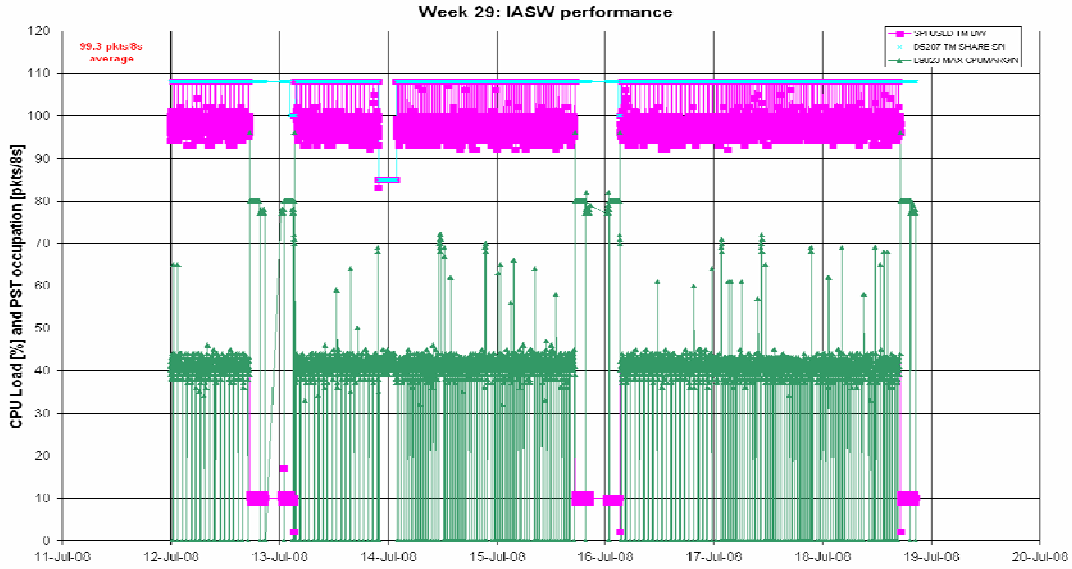


DPE & IASW: The DPE health and IASW performance is nominal.

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

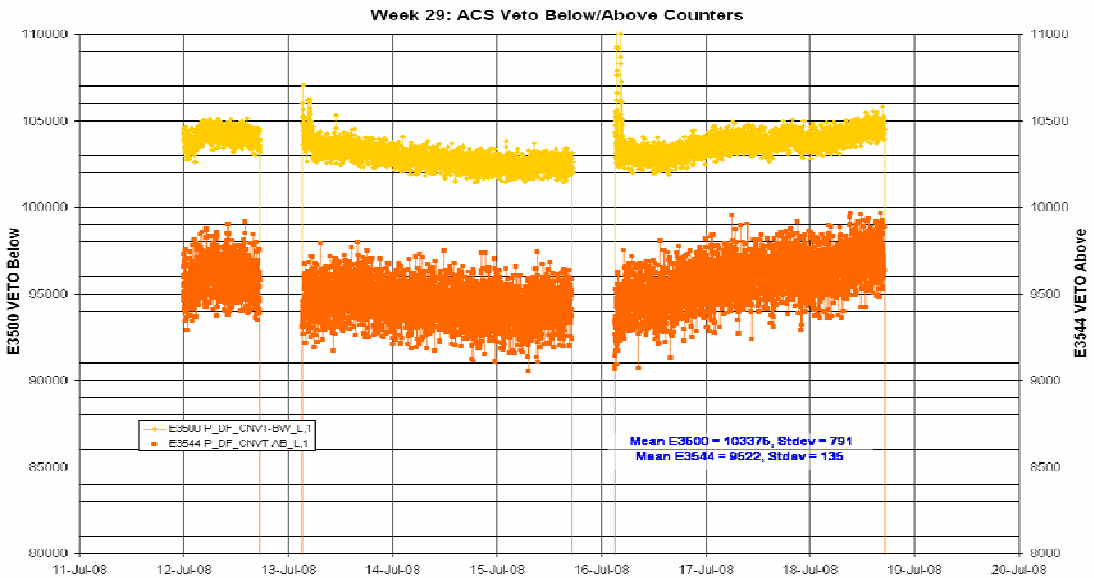
The average TM bandwidth occupation of SPI was 99.3 packets/cycle over the science window when the TM allocation was 108 packets/cycle.

The following plot shows the IASW performance in terms of TM bandwidth occupation and DPE CPU load during the reporting period. Note that from 2008-07-13T21:59:06Z to 2008-07-14T01:46:42Z, the TM allocation was 85 packets/cycle due to an OMC Flat Field Calibration.

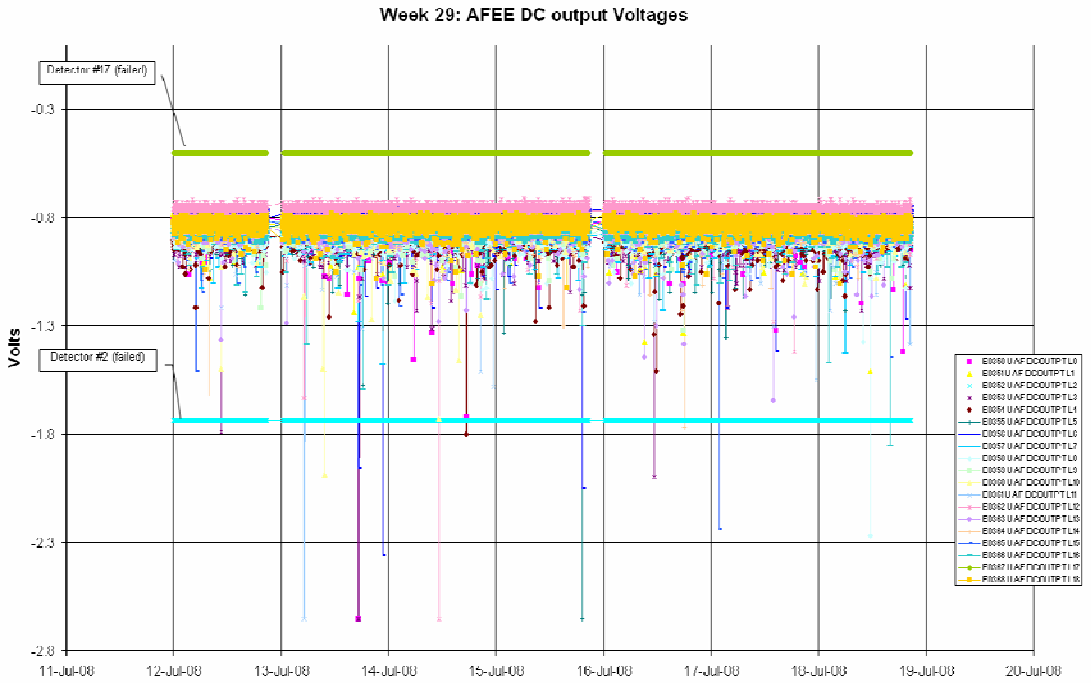


ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61).

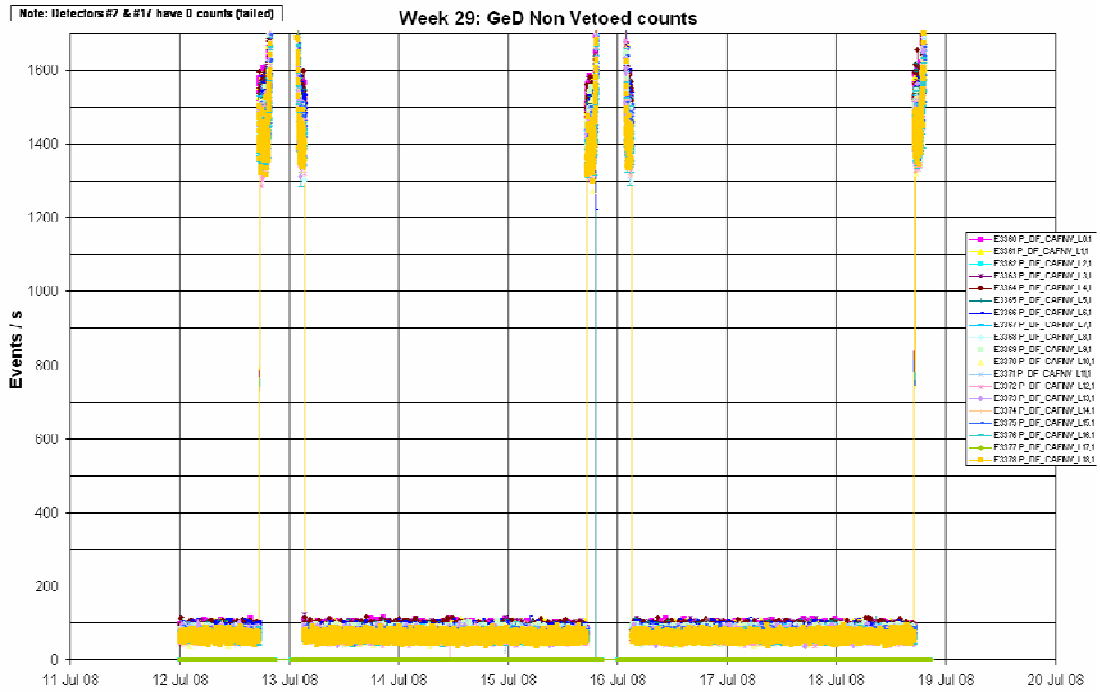
The following plot shows the ACS overall count rate evolution during the reporting period:

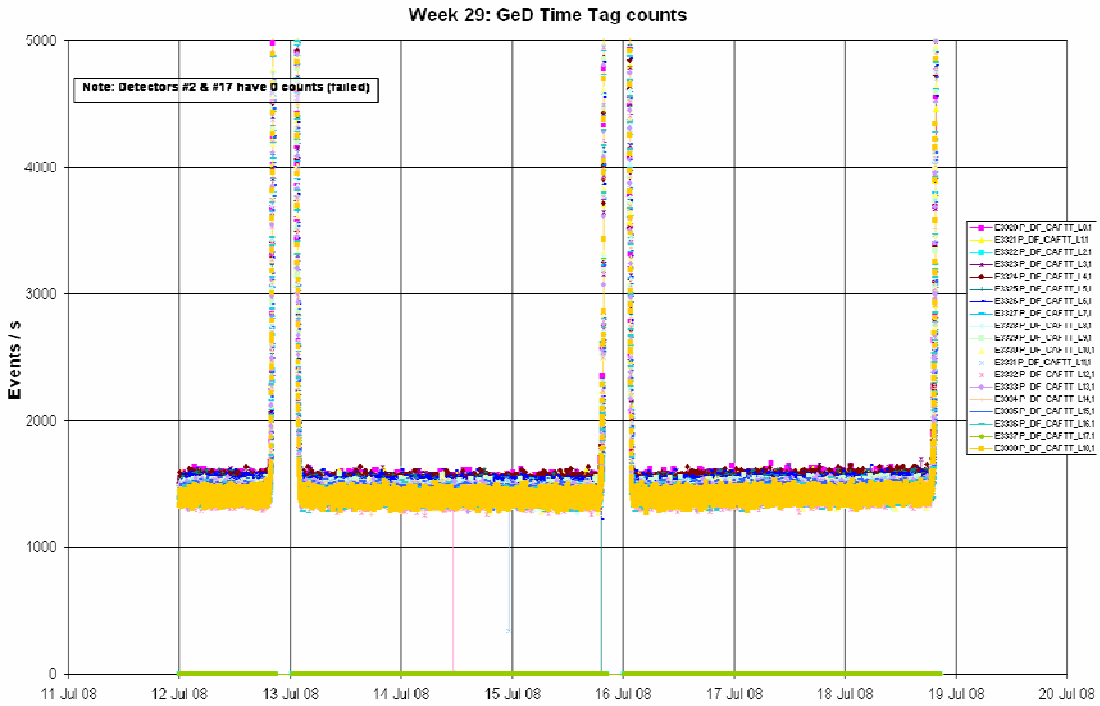


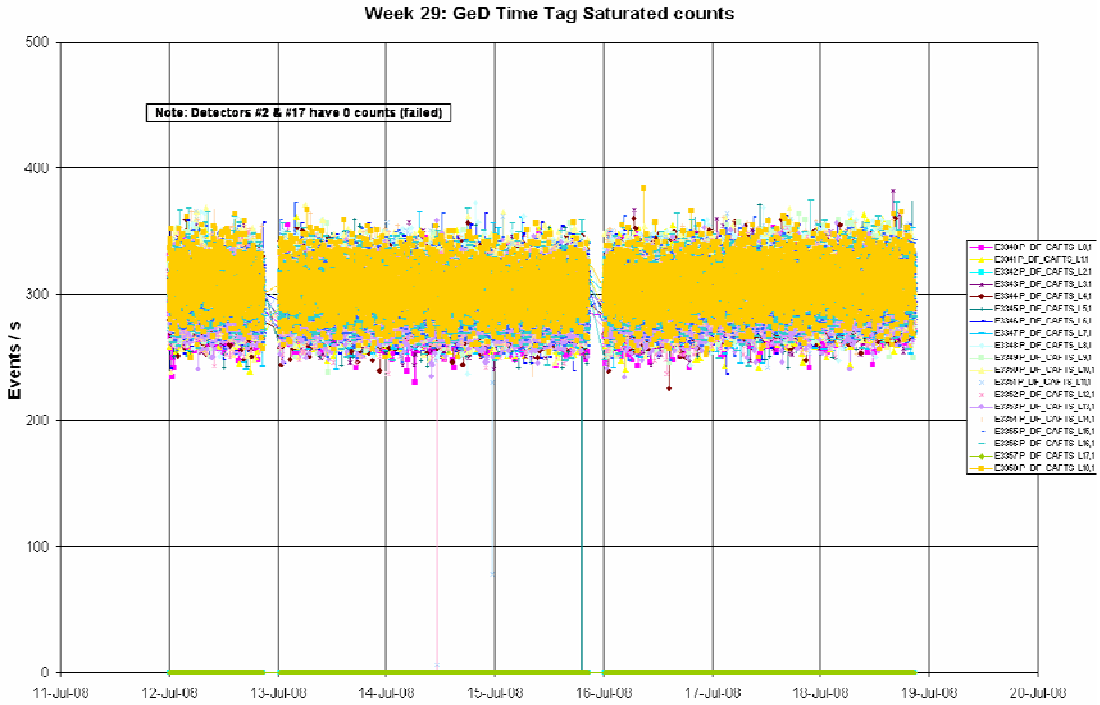
AFEE: The health of the AFEE is nominal. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003 and detector #17 is failed since 17/07/2004.



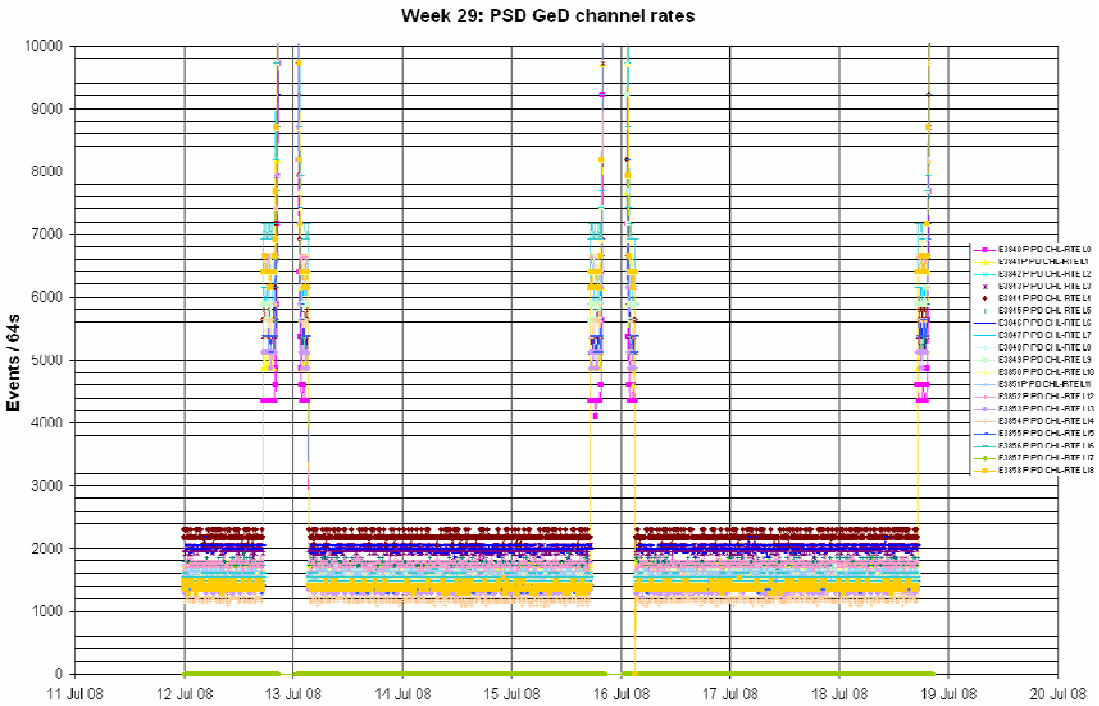
DFEE: The performance of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.







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



Event Log:

The following alarms were received from SPI over the reporting period:

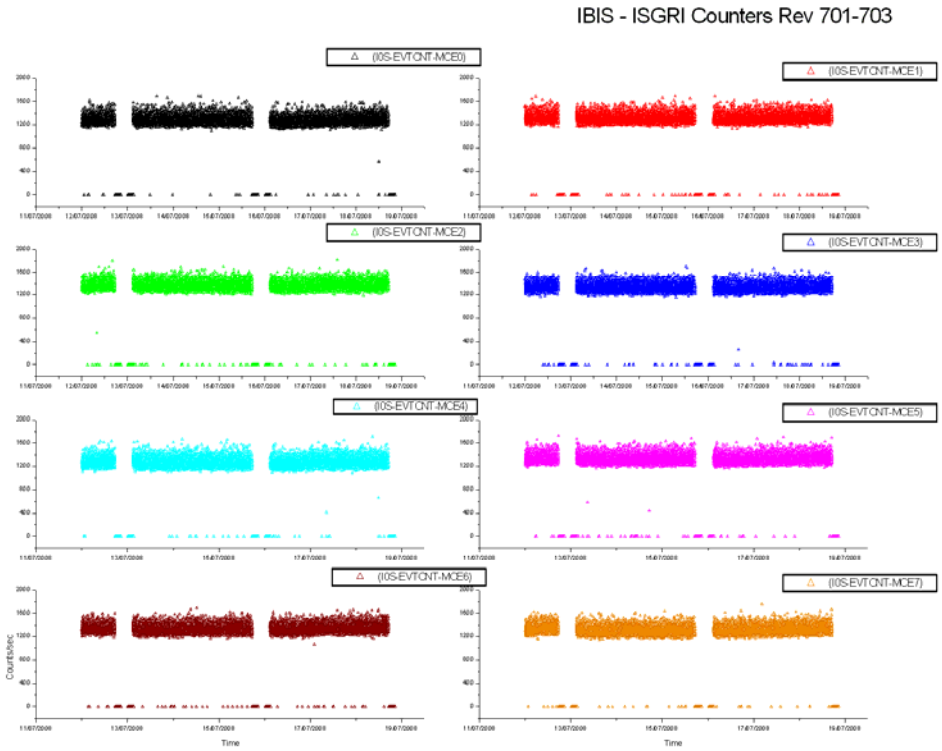
- As usual following a change of TM allocation from a low value to the nominal value after an OMC Flat Field Calibration, the following OEMs were received on 2008-07-14: indicating a problem with the spectra compression:
  - From 01:59:27Z to 02:04:55Z 17 occurrences of OEM APID 1024 ID 245 EXCEPTION SPI1 SPECTRA COMPRESSION OVERFLOW (1 for each detector).
  - At 02:04:55Z OEM APID 1024 ID 244 EXCEPTION SPI1 SPECTRA COMPRESSION NOT COMPLETED.

  As these stopped of their own accord, no action was taken.

8.3.3 IBIS Operations

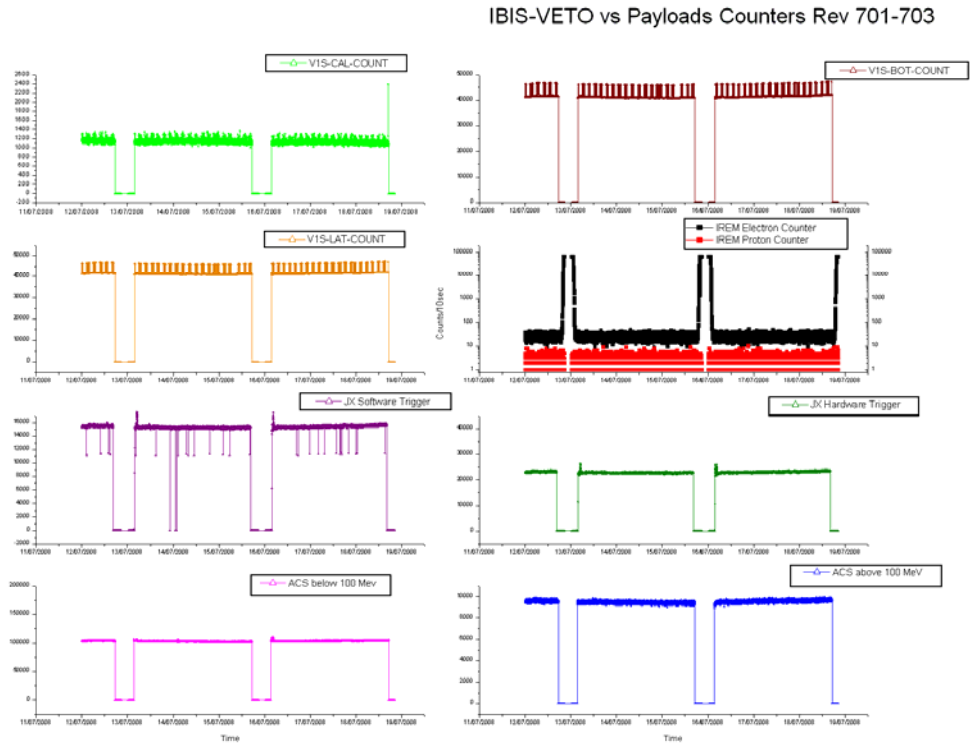
IBIS Event Counters Plots

ISGRI Counters:



**sampling every 4 pkts (32 secs)

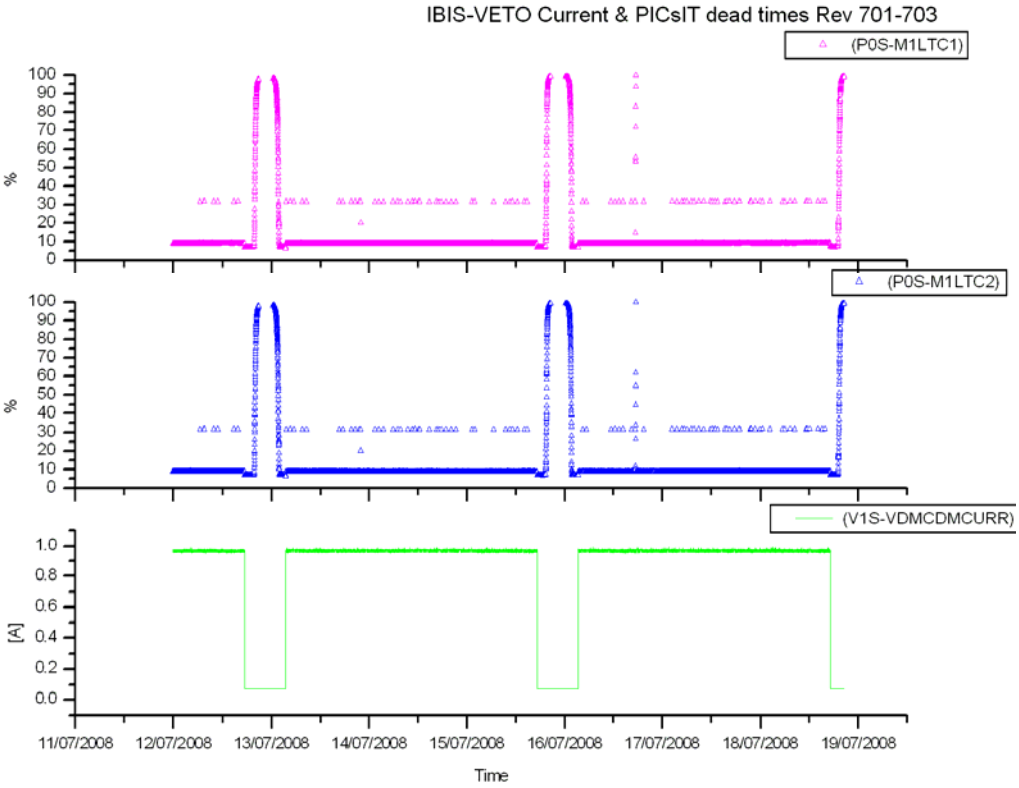
VETO vs Payload Counters:



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

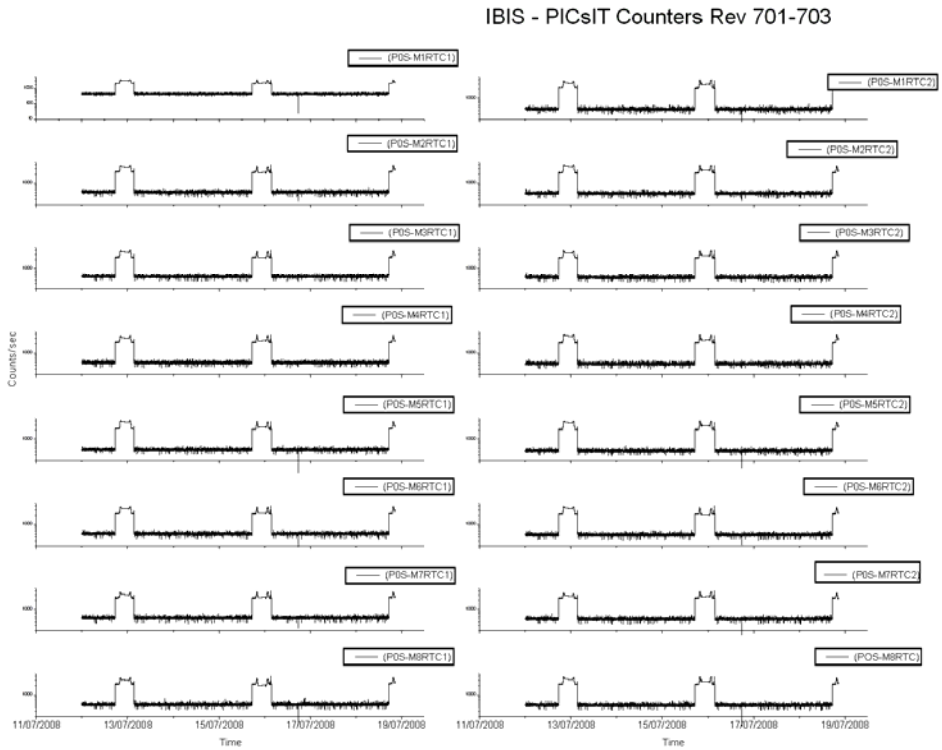
The week was characterised by low radiation as reported by the payload.

VETO Current:



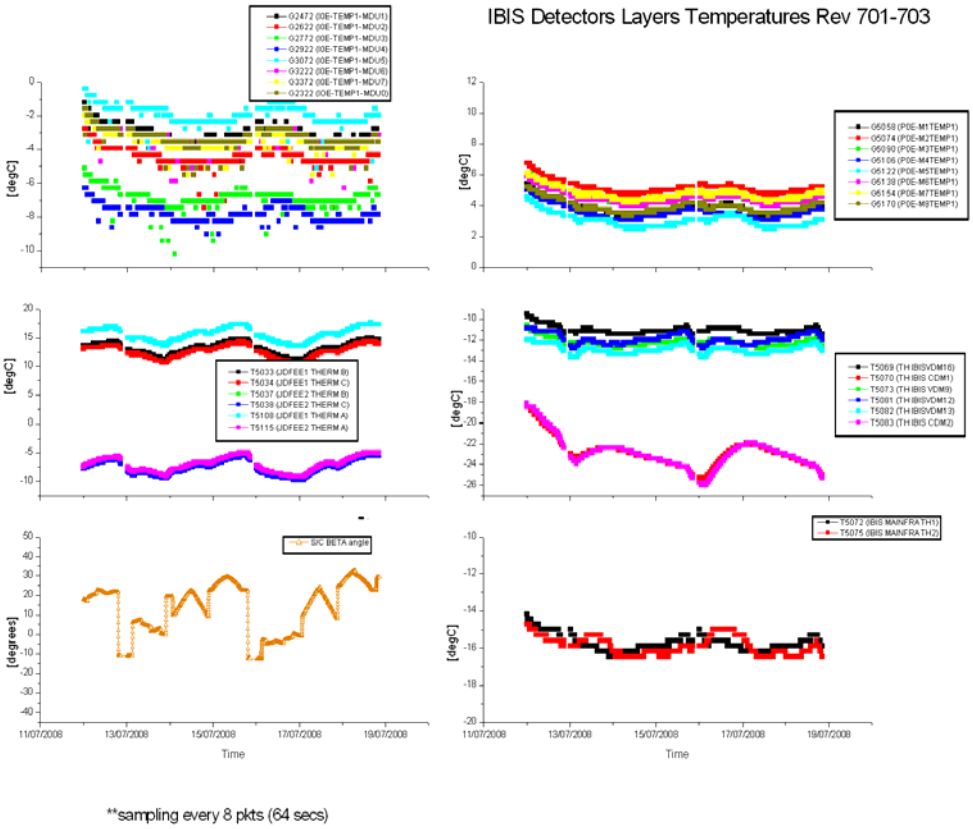
**sampling every 4 pkts (32 secs)

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.

2008-07-12 (DOY 194, Rev 701-702) to 2008-07-15 (DOY 197, Rev 702-703)

IBIS operations executed nominally.

2008-07-16 (DOY 198, Rev 703)

At 17:30:00Z the TM parameters families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 17:32:51Z the TM parameter families G5002 and G5003 for the PDM semi-module counters started going OOL Low. As these were followed at 17:36:08Z by OEM APID 1280 ID 132 EVENT IBIS1 IASW HEPI RESYNCHRONIZED, indicating that HEPI resynchronised autonomously, by which time all the above parameters had returned within limits, no action was taken.

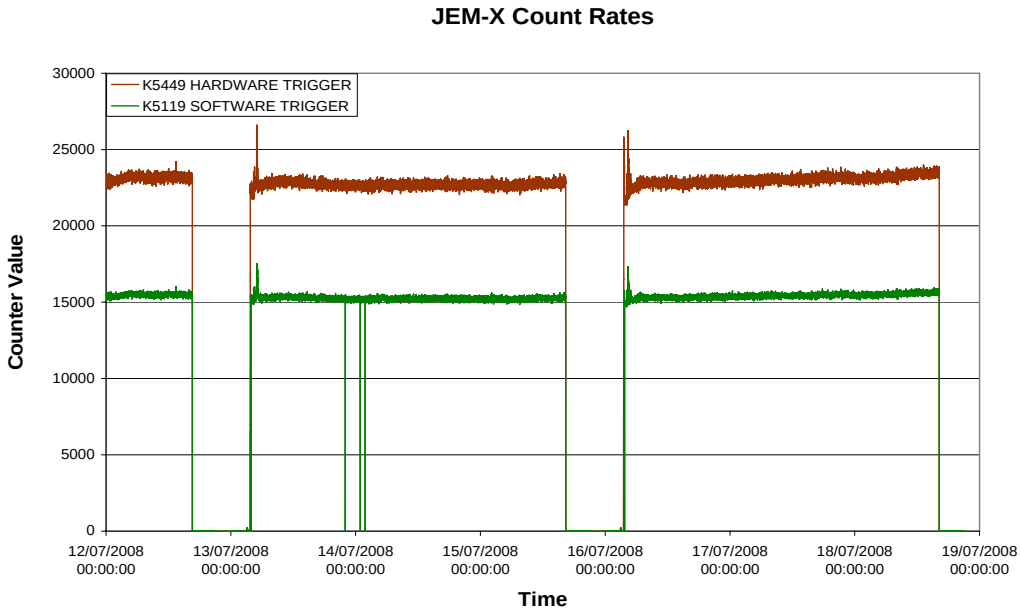
2008-07-17 (DOY 199, Rev 703) to 2008-07-18 (DOY 200, Rev 703-704)

IBIS operations executed nominally.

8.3.4 JEM-X Operations

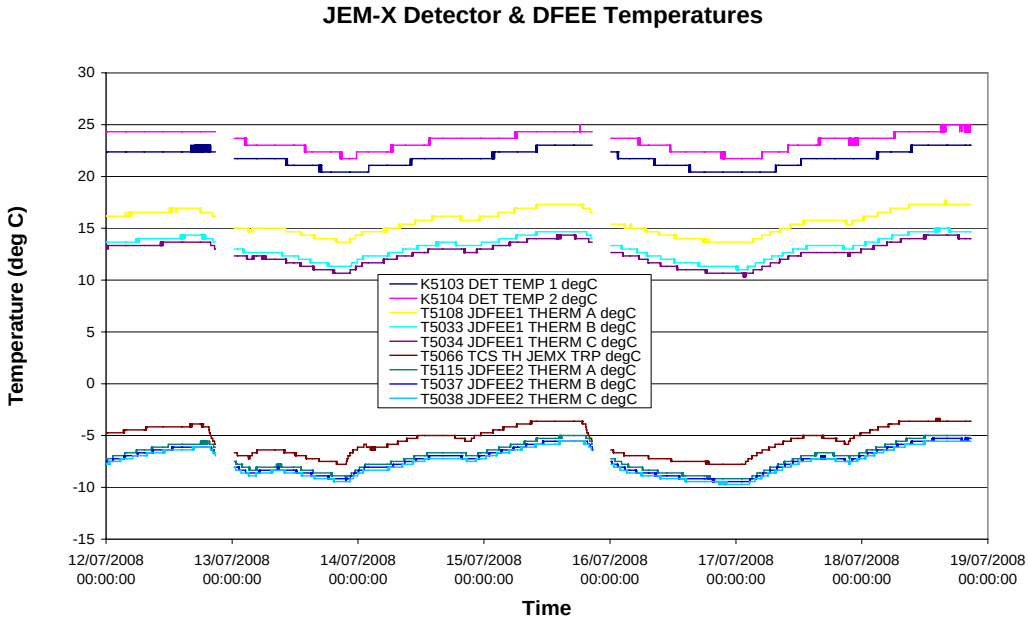
JEM-X Count Rates

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

2008-07-12 (DoY 194, Rev 701)

At 16:34:46, TC KU0014 terminated with status affected, and 6 seconds later this changed to status unverified. No action was taken, and there was no impact.

2008-07-13 (DoY 195, Rev 702) to 2008-07-18 (DoY 200, Rev 703)

JEM-X1 operations executed nominally.

8.3.5 OMC Operations

2008-07-12 (DoY 194, Rev 701)

Nothing to report.

2008-07-13 (DoY 195, Rev 702)

From 21:59:22 to 00:50:55, a Flat-Field calibration (#27) was performed. This was followed from 00:51:25 to 01:23:05 by a Dark-Current calibration. Both were performed nominally.

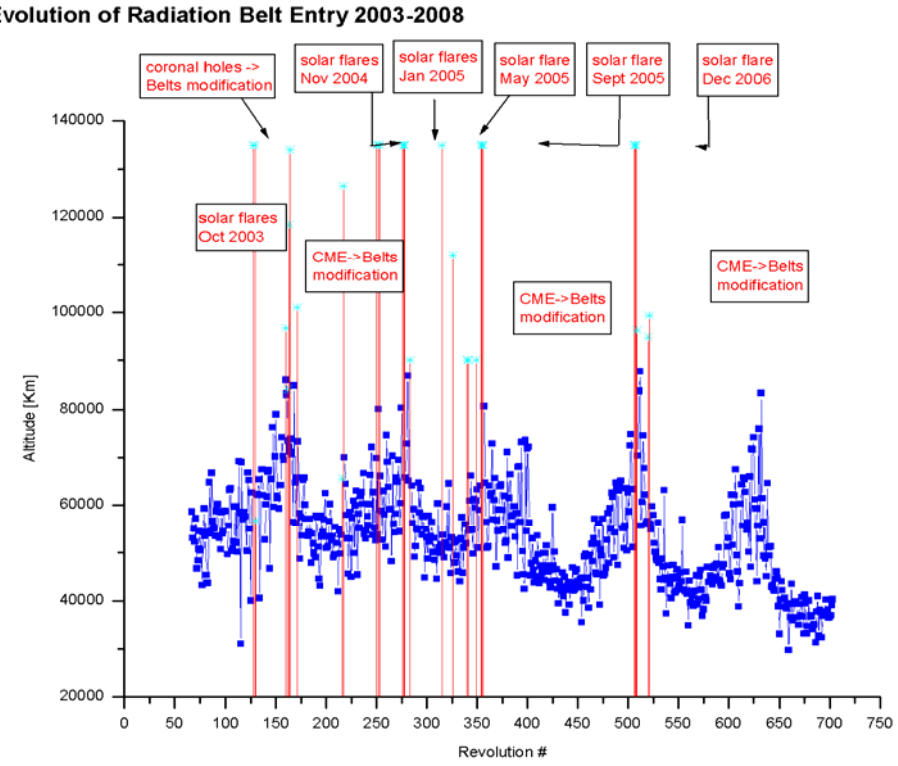
2008-07-14 (DoY 196, Rev 702) to 2008-07-18 (DoY 200, Rev 703)

Nothing to report.

On DoY 194 at 17:27:25, DoY 197 at 17:17:57 and DoY 200 at 17:08:06 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

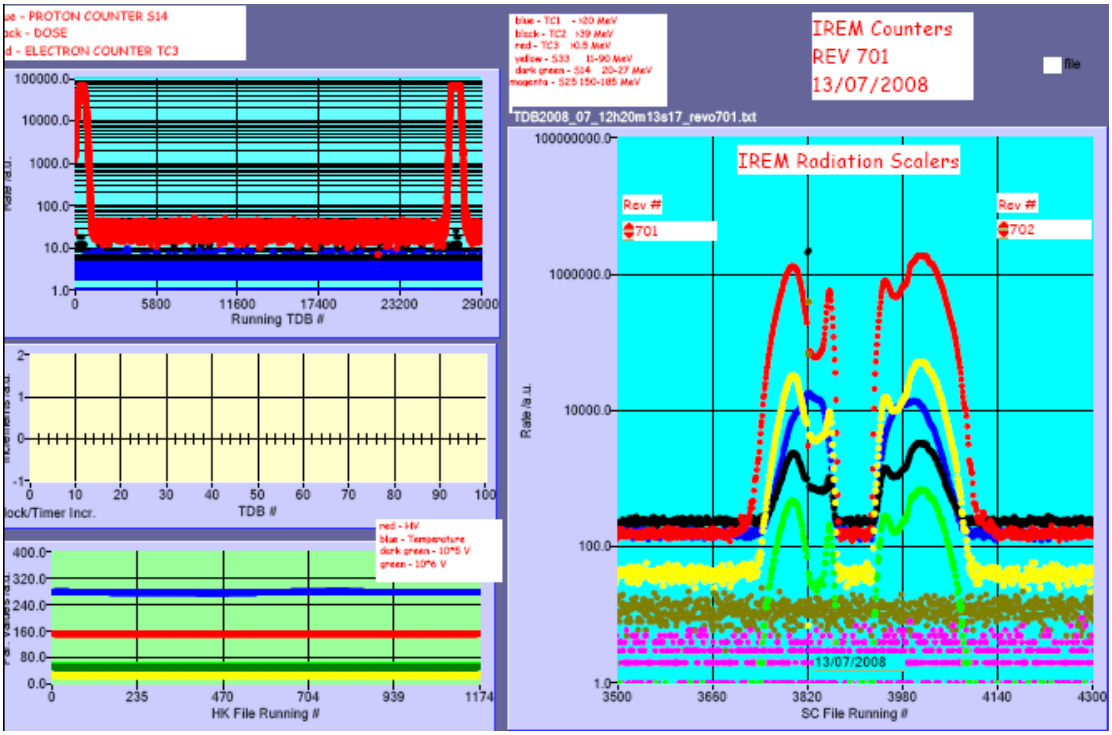
Nothing to report.

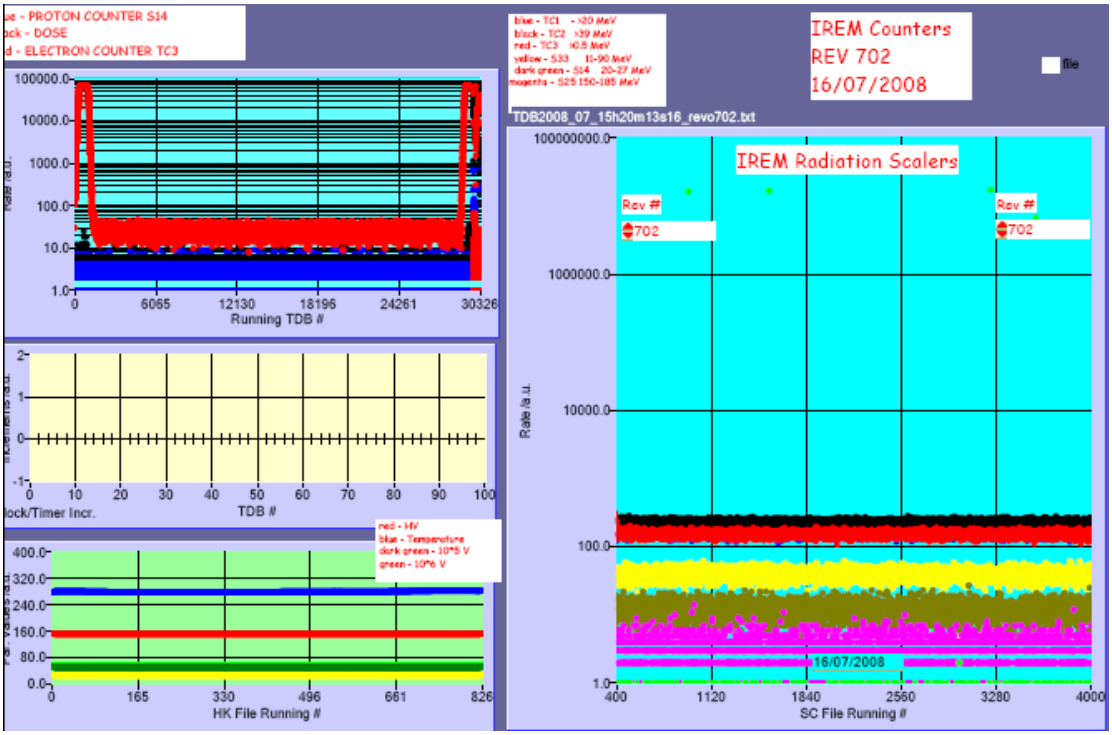
Electron Belts

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]
701	RAD_ENTR R 2008-07-12T17:27:17Z	12/07/2008 19:35:00	36956.3	12-Jul-2008 19:26:11	38705.93
702	RAD_EXIT R 2008-07-13T03:20:11Z	13/07/2008 02:10:12	>>33566.4	13-Jul-2008 02:36:11	46210.65
702	RAD_ENTR R 2008-07-15T17:17:49Z	15/07/2008 19:10:28	39072.4	15-Jul-2008 19:13:24	39238.16
703	RAD_EXIT R 2008-07-16T03:10:12Z	16/07/2008 02:15:40	>>33584.2	16-Jul-2008 02:23:24	45783.54
703	RAD_ENTR R 2008-07-18T17:08:03Z	18/07/2008 18:54:28	40285.5	18-Jul-2008 19:03:24	39371.76

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:

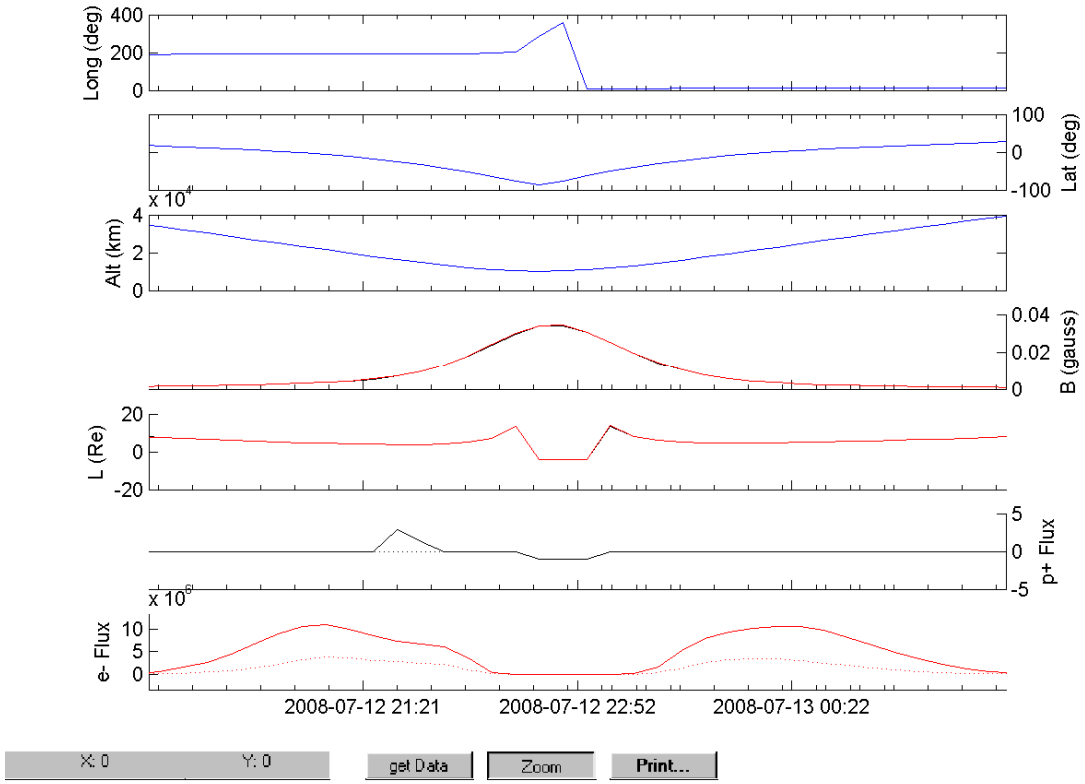




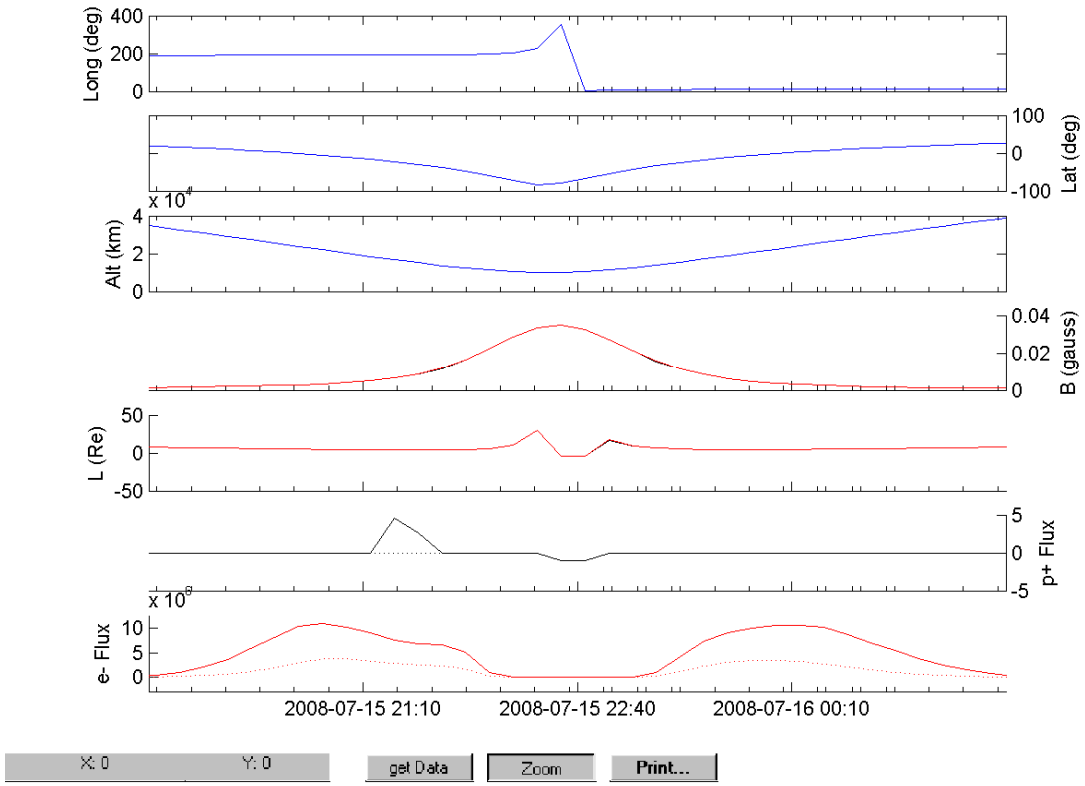
There was no data available for Revolution 703.

IREM Predicted Radiation Belt Passages

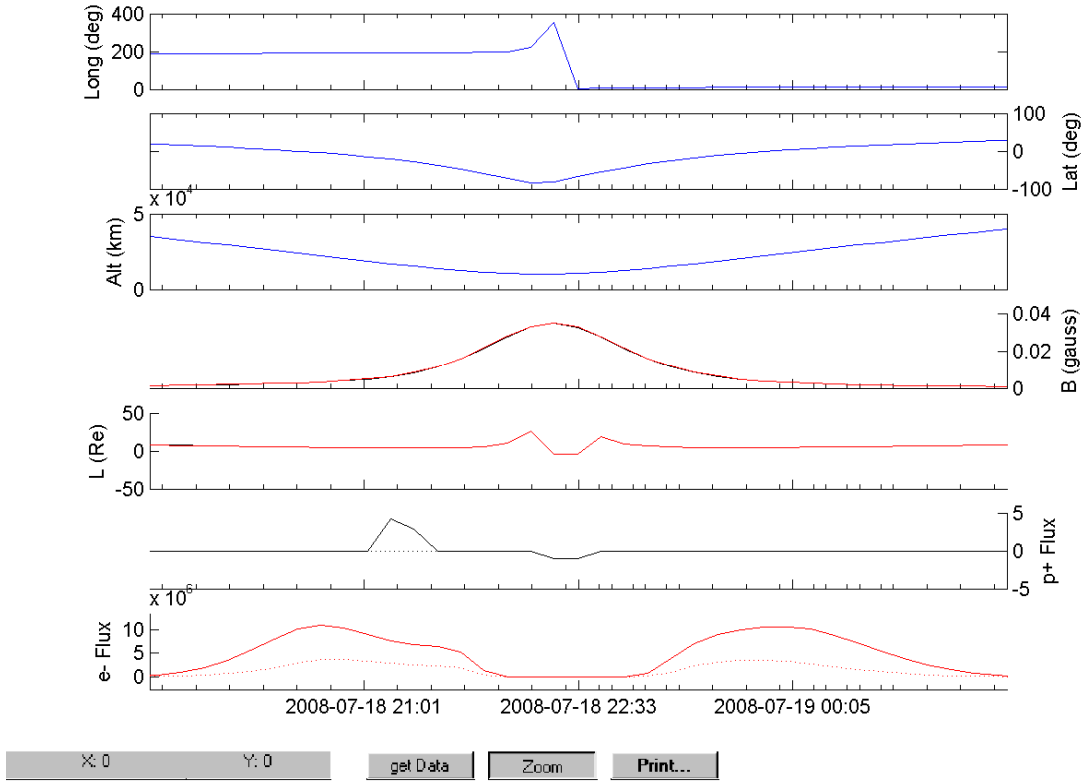
Rev 701



Rev 702



Rev 703



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.