

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 361
Week 34
24.08.09
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 15.08.09 until 21.08.09 (both dates inclusive) and covers the revolutions 835 and 836.

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 the Perseus Arm region (RA 04:46:58.46, +45:14:46.4), a target of opportunity a hexagonal dither of the Be/X-ray binary system 1A 0535+262 (RA 05:38:54.57, +26:18:56.8), a raster dither of the galaxy MCG +8-11-11 (RA 05:54:53.60, +46:26:21.6) and a hexagonal dither of the Galactic bulge region (RA 17:45:36.00, -28:56:00.0).

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 slews were missed from the timeline.

The fuel consumption over the period between 15/08/2009 and 21/08/2009 was 0.0828 Kg. The remaining propellant is in the order of 132.7394 Kg.

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

3.1.2 Power

All the other units of EPS are 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.

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

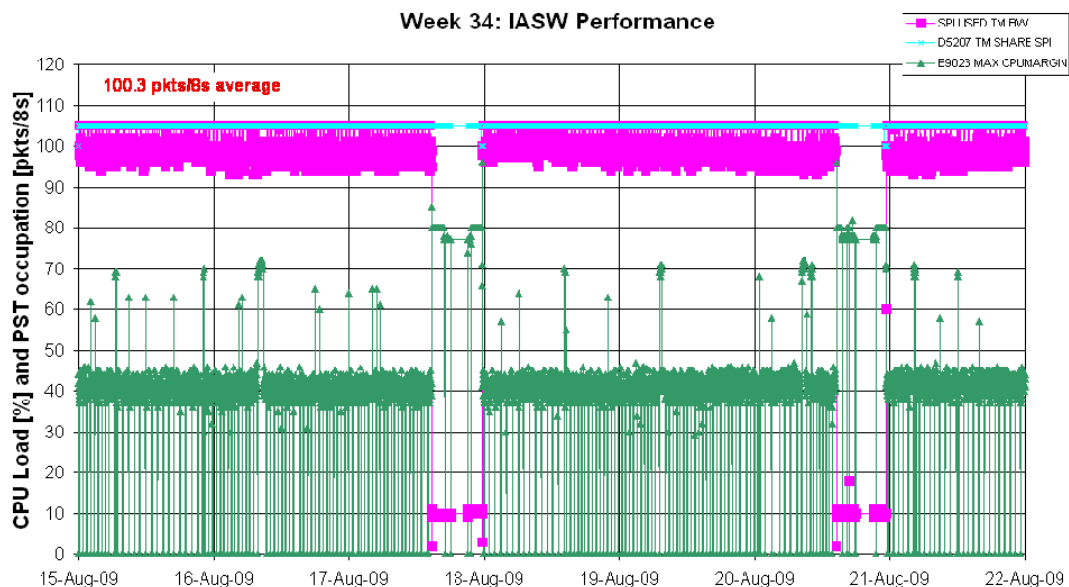
3.2.1 SPI

Following the 13th SPI annealing, which ended on 11/05/2009, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003); detector #17 (failed since 17/07/2004) and detector #5 (failed since 19/02/2009).

The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K.

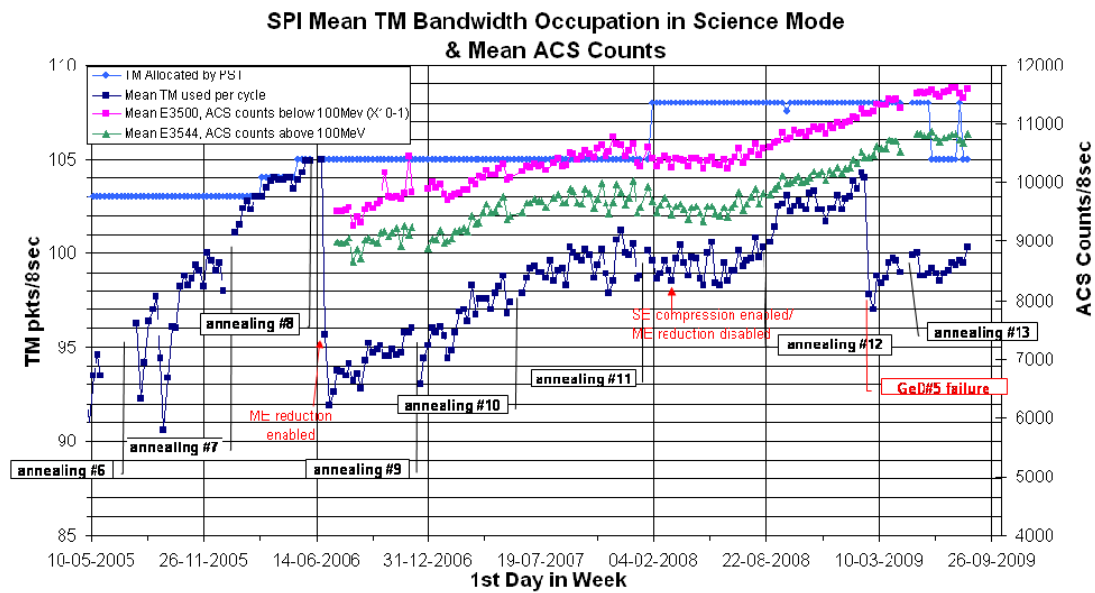
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle the average telemetry occupation was 100.3 packets/cycle.

The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period¹:



The following plot shows the evolution of the assigned and the average occupation of the SPI TM bandwidth since May 2005 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.

¹ Data sampled every 8th packet (64sec)



Note: Some more information concerning the SPI operations is provided in the Appendix 8.3.2.

3.2.2 IBIS

The overall status of IBIS is nominal.

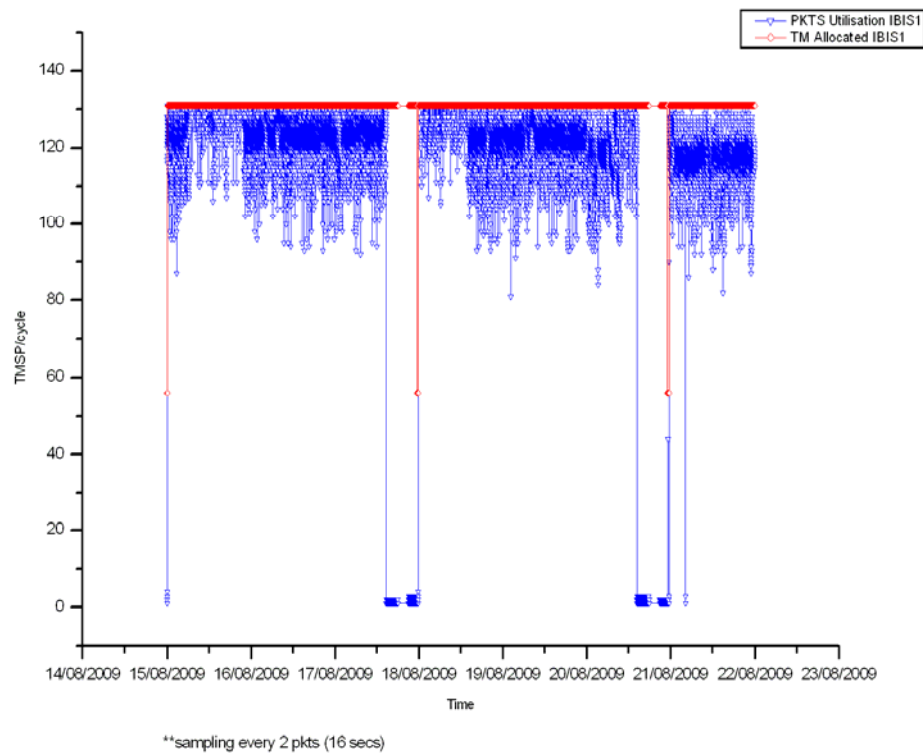
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 122.83 packets/cycle (up 1.2 on previous week)
- Percentage of TM cycles for which full bandwidth was used: 23.1%

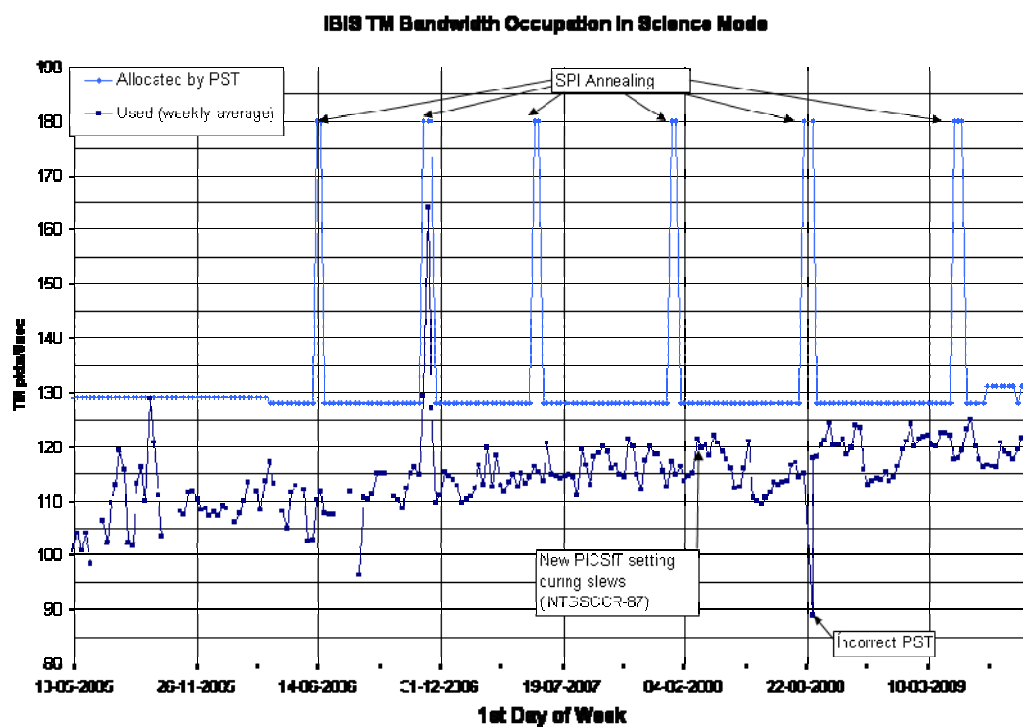
The plot below shows the IBIS TM utilisation during the reporting period²:

² Data sampled every 2nd packet (16sec)

IBIS - TM Bandwidth Utilisation Rev 835-837



A plot of the IBIS weekly bandwidth utilisation since May 2005 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 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, 186 of the 187 planned science pointings were executed nominally, 1 was cut short.

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

3.2.5 IREM

The overall status of the unit is nominal.

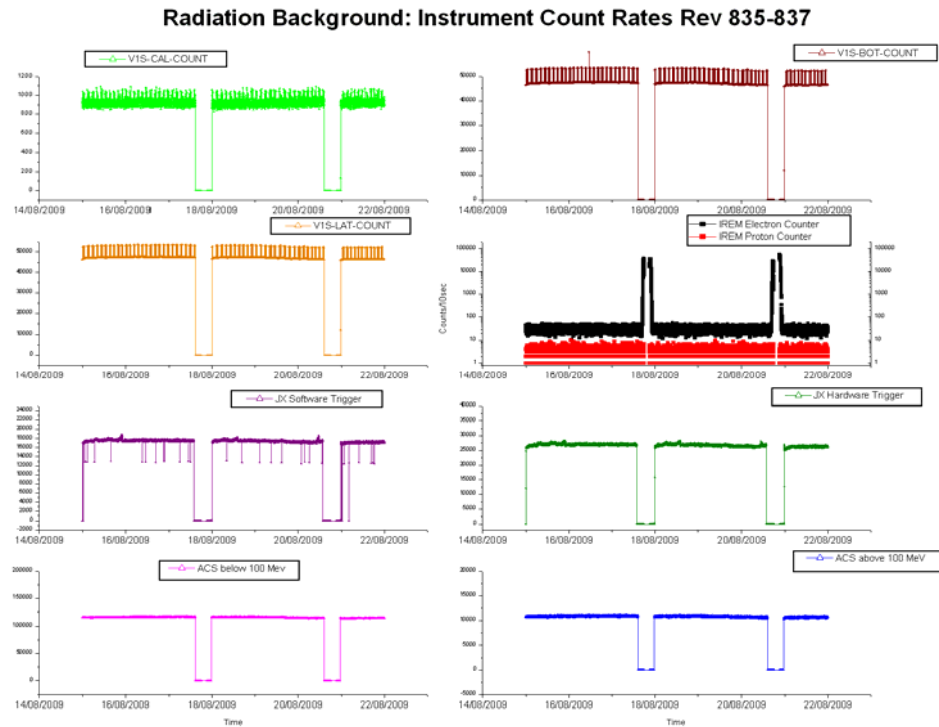
Solar Activity

The observation period was characterised by low solar activity. The sun was blank all week. The risk of solar flares was very low.

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

3.2.6 Radiation Background

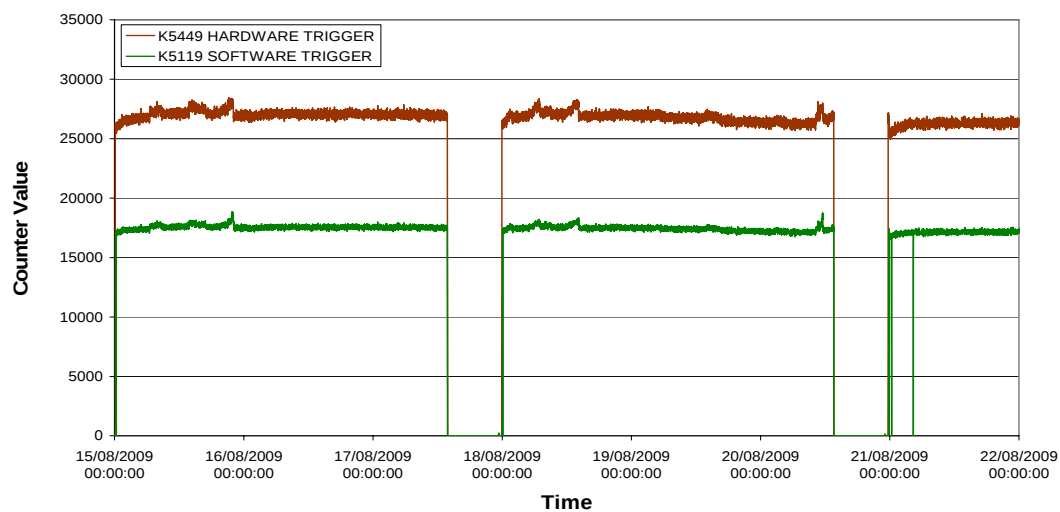
The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week³:



JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph⁴.

JEMX-1 Count Rates

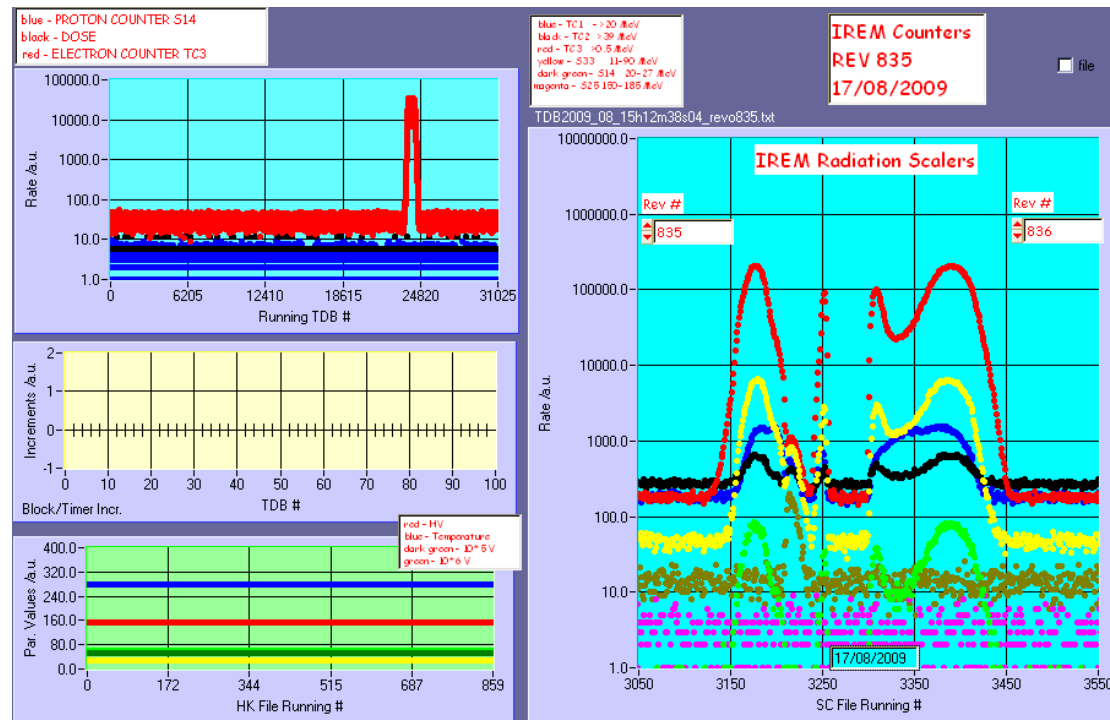


³ Data sampled every 6th packet (48sec)

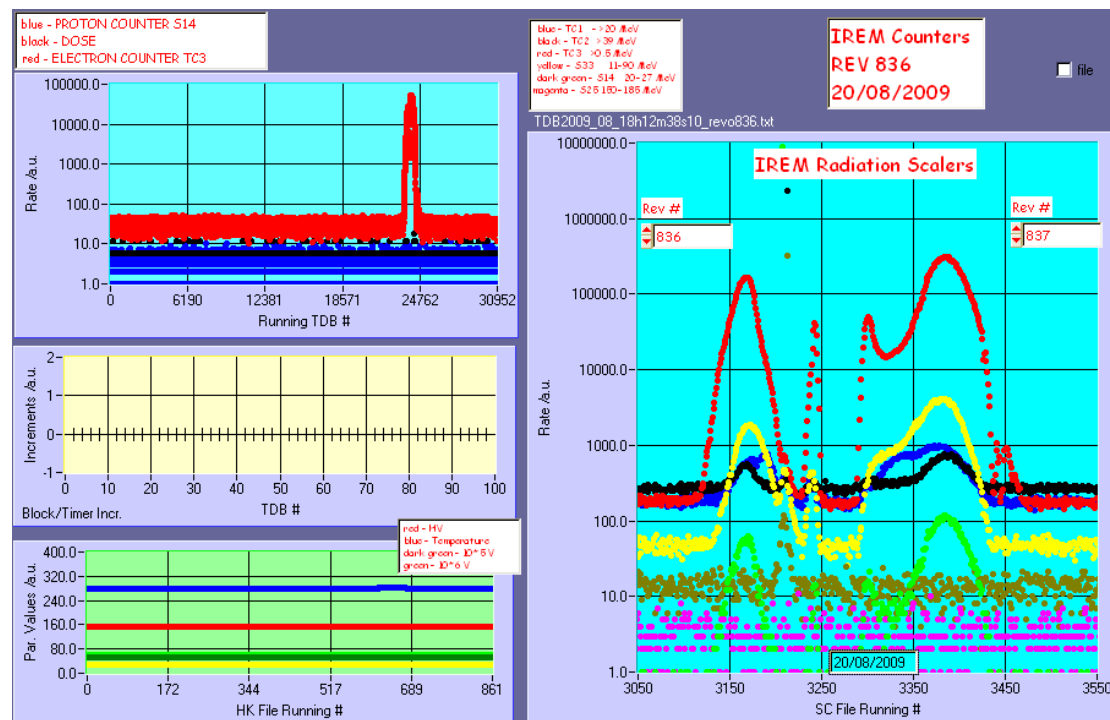
⁴ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

IREM radiation counters:

Revolution 835



Revolution 836



4 Ground Facilities

The Operational ground facilities performance was good this week. The overall performance was over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week, there were two occasions when the links with ISDC dropped, necessitating a restart of the isds & ifrd, there was no impact.

4.2 Ground Stations & Network

The performance of the ground stations and Network was good this week. There were two occasions of a TM drop VC0 and VC7 from DSS-27. One caused the interruption of a change of guide star sequence which was re-uplinked afterwards. There was one occasion of a TM drop VC0 and VC7 from Redu.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 841 to 844.

New observations have been planned for revolutions 838 to 844, including Crab calibration observations in revolution 839. Planning files for revolutions 843 and 844 were still awaiting approval by the Project Scientist.

New TSFs have been received for revolutions 837 and 838.

2. Observation status

New ECS files have been received and processed for revolutions 825 and 826.

3. ISOC Science Data Archive

No new data has been ingested as work has been focussed on preparing for OSA 7 results. The last ingested revolution is 810.

4. ISOC system

No news.

5. Problems

None.

5 Special Events

6 Anomalies

No new anomaly reports were entered this week

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Consumables

8.2 Detailed Satellite Information

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

8.2.1 AOCS SUMMARY OPERATIONS REPORT, 15/08/2009 – 21/08/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 129 Open Loop Slews, 73 Closed Loop Slews and 4 Momentum Biases were executed (as reported by ACC OEM).

No slews were missed from the timeline.

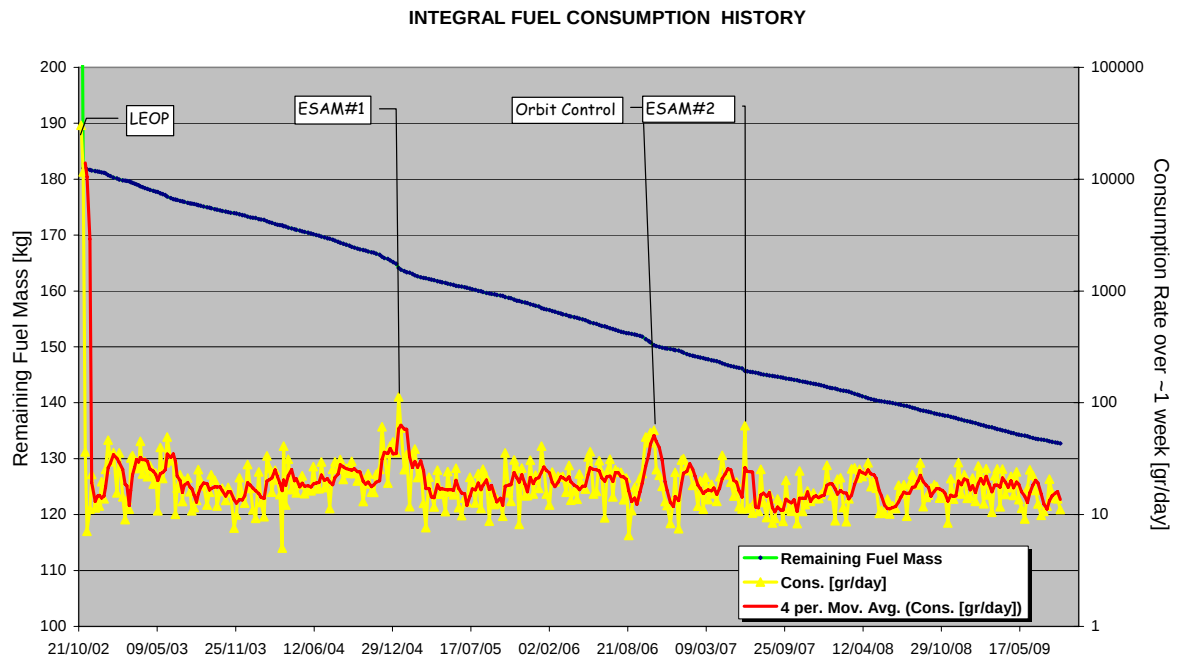
The OTF was not reached for PIDs 08350036, 08350041, 08360015, 08360025, 08360043, 08360044 and 08370003.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 21/08/2009 is reported in the plot below.

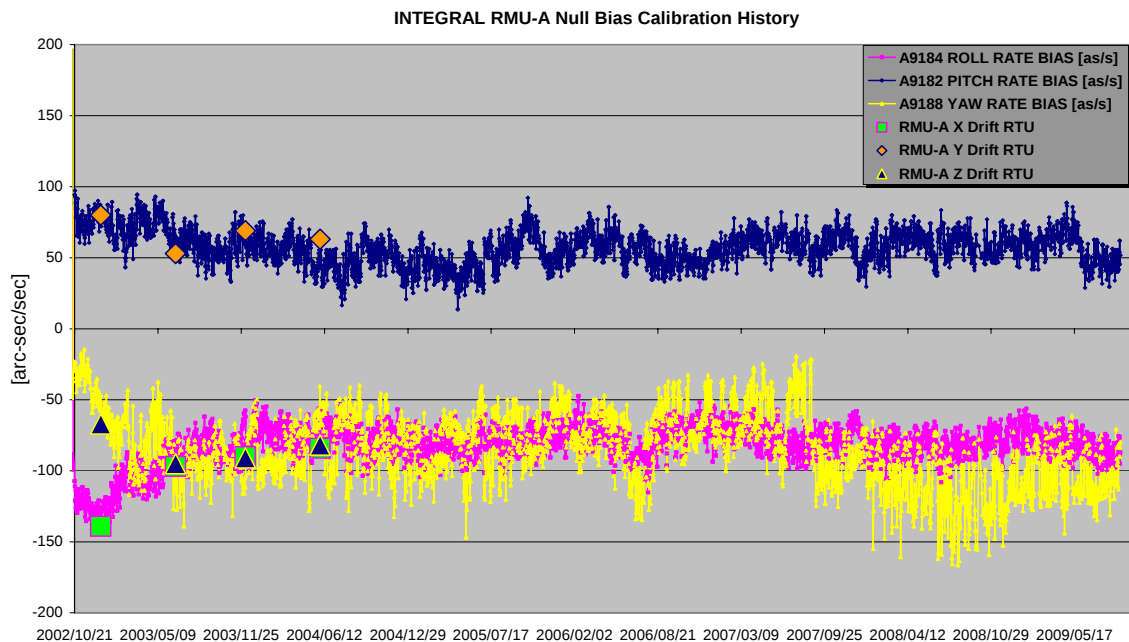


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

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 21/08/2009 is reported in the plot below.

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.



Daily events Log:

15/08/2009 (Day of Year 227, Revolution 835)

Nothing to report

16/08/2009 (Day of Year 228, Revolution 835)

- Loss of guide star at 04:22:09. Since this happened only one second after the previous SLEW (08350036) END, the IMU1 didn't switch on but, instead, a mapping was commanded and another star picked. The OTF was lost at this point.

Five minutes later (04:29:00), the star tracked on slot 1 was lost. Then the IMU1 came on. After the IMU1 switched OFF, a manual mapping was commanded and the parameters for slew 08350037 updated via spacontool.

- Update for slew 08350042 failed (08:07:00), because in the mapping processed by FD there was only one full accuracy star (attitude determination failed). A manual mapping was commanded (where this time more than 1 full accuracy star was tracked. Attitude determination succeeded) and the parameters for slew 08350042 were updated via spacontool.

- Loss of guide star at 08:04:17, that is, 9 seconds after SLEW END (08350041). The IMU didn't switch ON. A mapping started autonomously and a new star was tracked in slot 1. The OTF was not reached for PID 08350041

17/08/2009 (Day of Year 229, Revolution 835 to 836)

Nothing to report

18/08/2009 (Day of Year 230, Revolution 836)

- Update for slew 08360016 failed (13:10:00), because in the mapping processed by FD there were not enough full accuracy stars (attitude determination failed). Besides, the guide star was lost shortly after slew end, leading to OTF not reached.

A manual mapping was commanded (where this time more full accuracy stars were tracked. Attitude determination succeeded) and the parameters for slew 08360016 were updated via spacontool.

The OTF was not reached for PID 08360015

- OTF not reached for PID 08360025 (19:51:00). The OTF was reached directly after the completion of the slew, but it was lost shortly after because of the loss of guide star.

19/08/2009 (Day of Year 231, Revolution 836)

- IMU1 switched ON during the stable pointing of PID 08360043 (08:21:00Z). A manual mapping was commanded and the parameters for slew 08360044 manually updated (spacontool).

No impact on the Timeline.

OTF was not reached for PID 08360043.

- IMU1 switched ON during the stable pointing of PID 08360044 (08:48:00Z). A manual mapping was commanded and the parameters for slew 08360045 manually updated (spacontool).

No impact on the Timeline.

OTF was not reached for PID 08360044.

20/08/2009 (Day of Year 232, Revolution 836 to 837)

- CGS failed (17:43:00) because of a TM drop (PTV failure) from Goldstone. After TM/TC were back, the commands were re-uplinked.

21/08/2009 (Day of Year 233, Revolution 837)

- IMU1 switched ON during the stable pointing of PID 08370003 (00:45:00Z). A manual mapping was commanded and the parameters for slew 08370004 manually updated (spacontool).

No impact on the Timeline.

OTF was not reached for PID 08370003.

8.2.2 SPI Operations

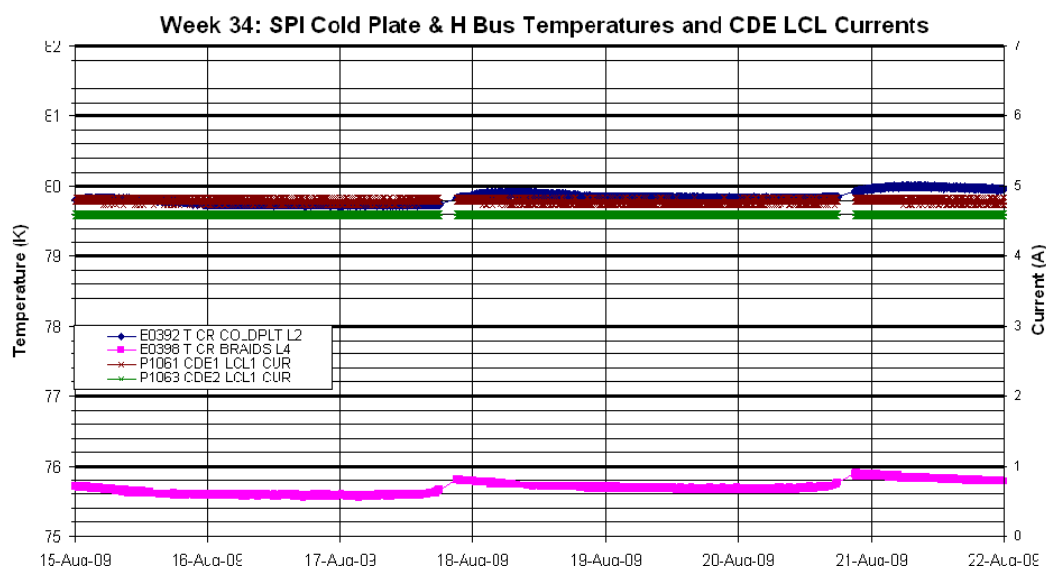
Unit Temperatures: All the equipment temperatures are inside the operational limits.

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 and the average CDE LCL currents were as follows:

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

The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period⁵:

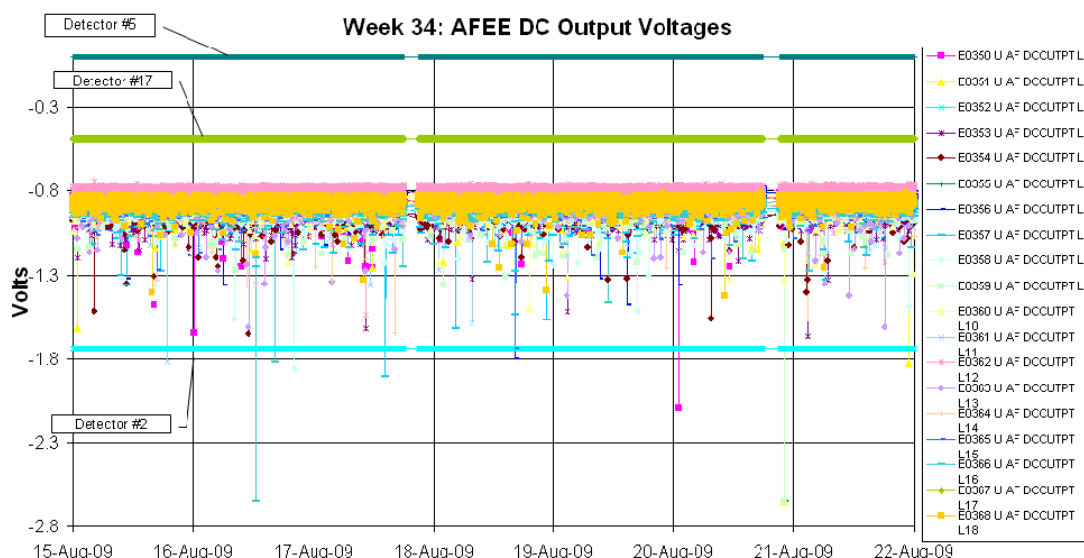


DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

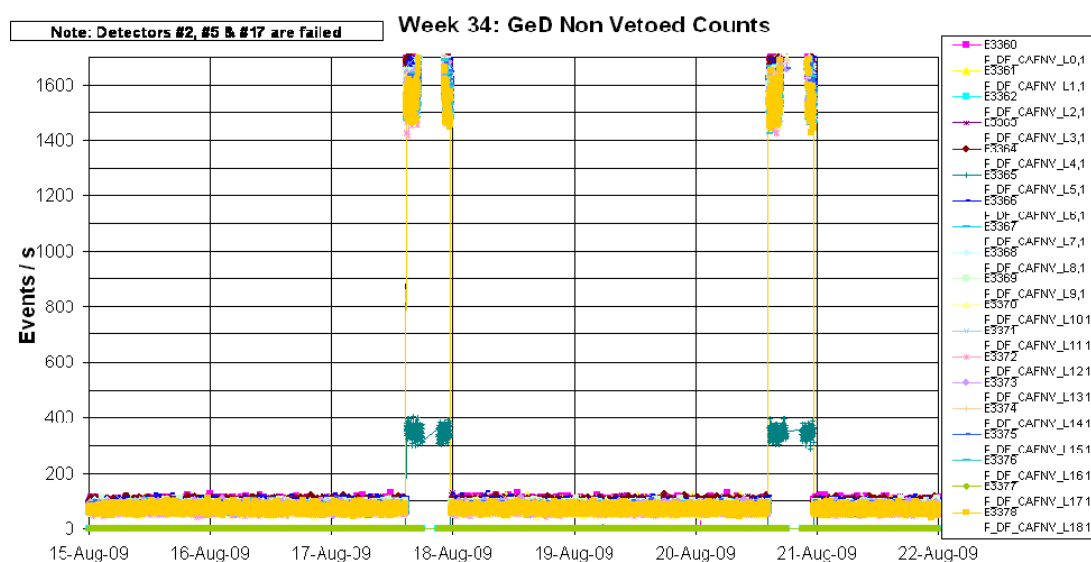
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

⁵ Data sampled every 8th packet (64sec)

AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period⁶. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the failed detectors are nominally set to 0.5kV.

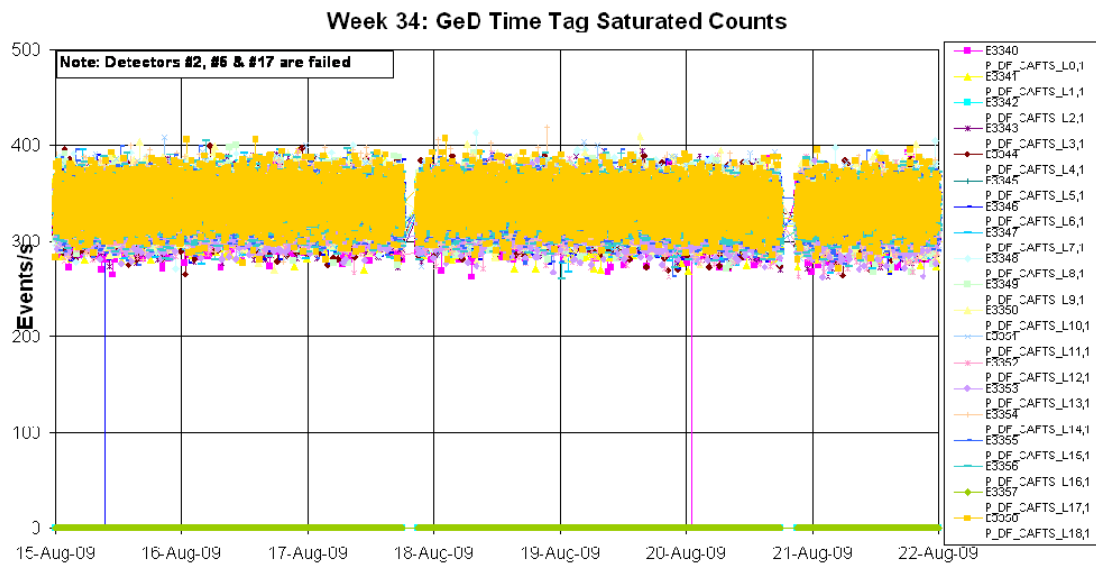
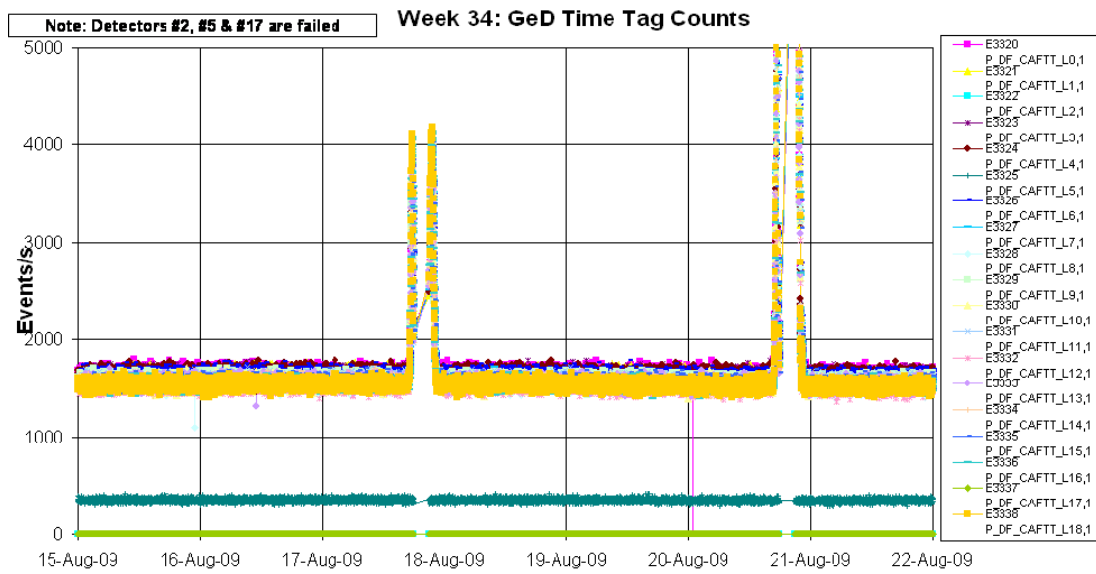


DFEE: The health of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period⁷.

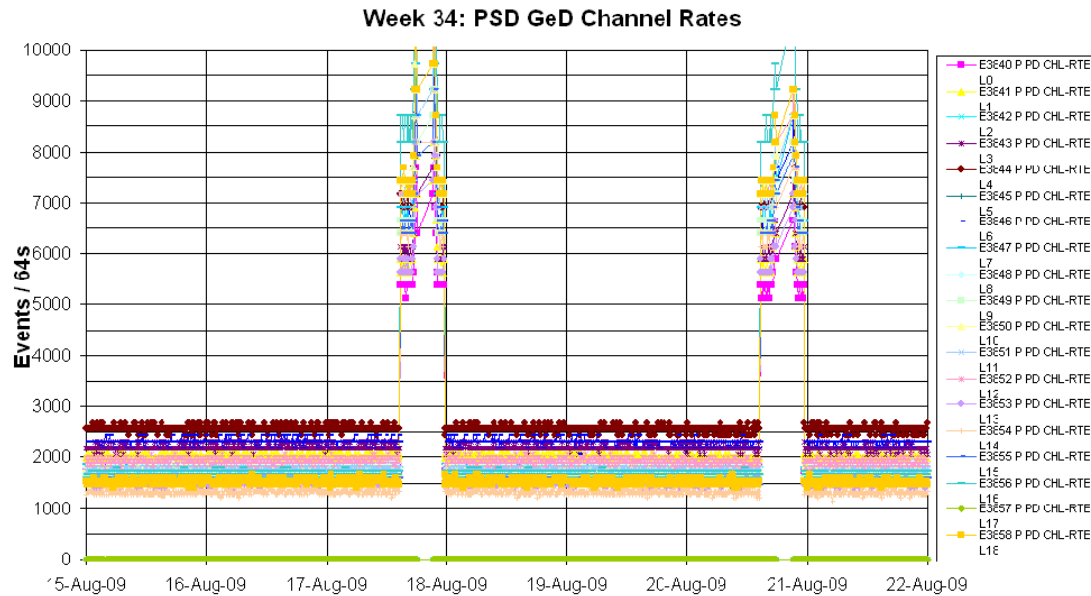


⁶ Data sampled every 8th packet (64sec)

⁷ Data sampled every 8th packet (64sec)



PSD: The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period⁸:



Event Log:

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

- On 2009-08-16 at 18:57:33Z TM parameter E2272 went OOL (value = PARAM > SPEC). This is the ACS FEE analogue status 5V #22. The TC sequence ES1831 to report the ACS HK parameters was sent at 19:07:22Z and the parameter returned within limits.

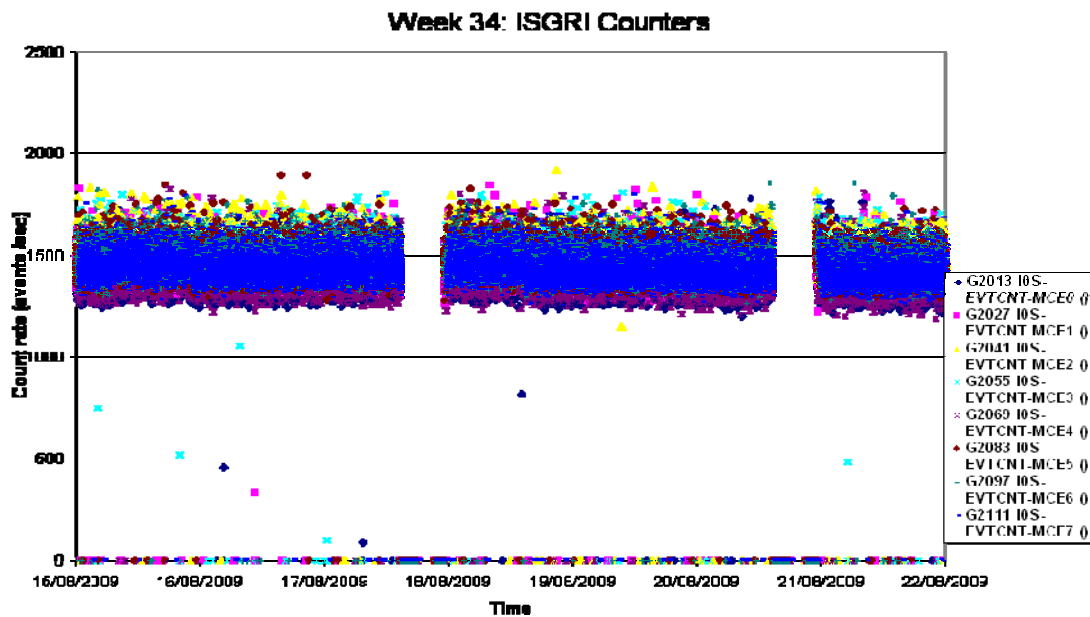
⁸ Data sampled every 8th packet (64sec)

8.2.3 IBIS Operations

Unit Temperatures: All the equipment temperatures were inside the operational limits throughout the week.

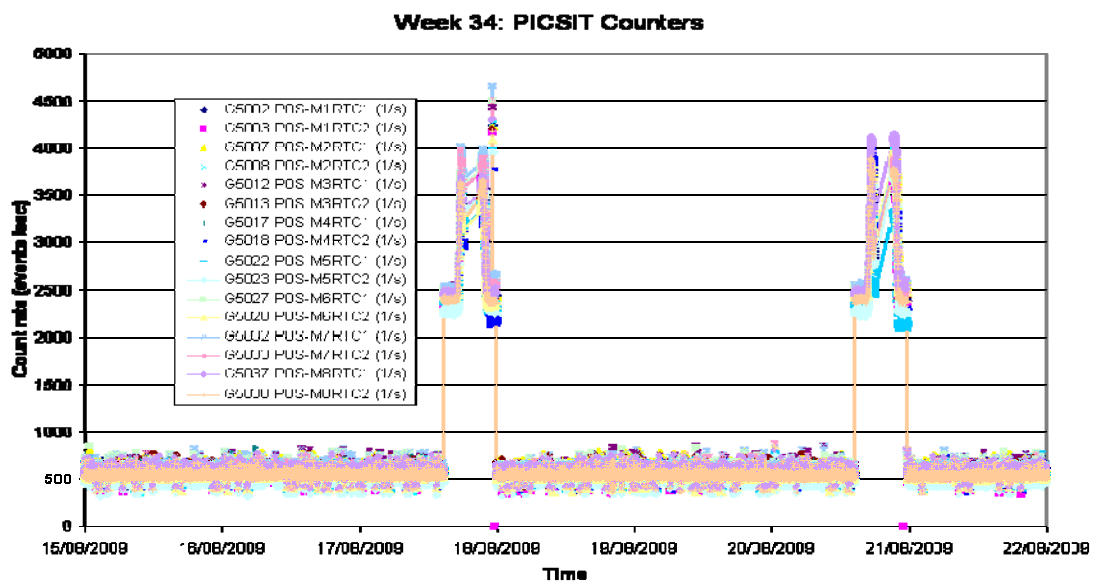
ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week⁹:



PICsIT

The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week¹⁰:

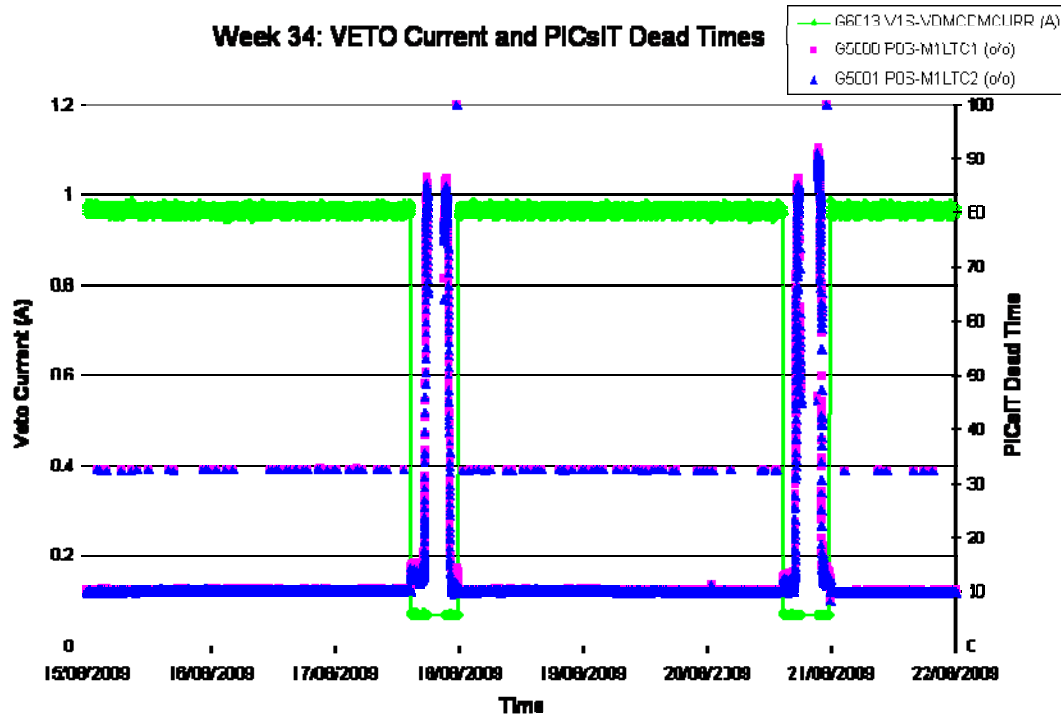


⁹ Data sampled every 4th packet (32sec)

¹⁰ Data sampled every 4th packet (32sec)

VETO

The health and performance of VETO was nominal during the reporting period. The following plot shows the VETO current and PICsIT dead-times during the week¹¹:



IBIS Daily Report

The usual Out Of Limits on TM parameter G8015 (S1E-A2_PMT_V), G5002 (POS-Mi_RTC1) and G5003 (POS-Mi_RTC2) families and G2000 family (IOE-OVFWPXADD-Mi) were received during the radiation belt passages.

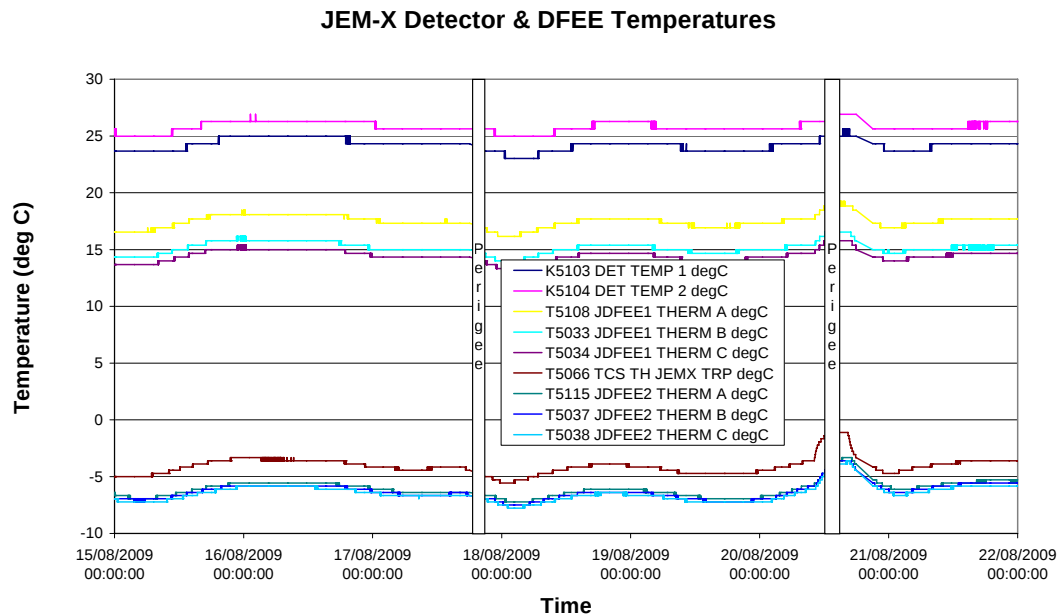
2009-08-15 (DOY 227, Rev 835) to 2009-08-21 (DOY 233, Rev 837)

IBIS operations executed nominally.

¹¹ Data sampled every 4th packet (32sec)

8.2.4 JEM-X Operations

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 graph¹².



JEM-X Daily Report

2009-08-15 (DoY 227 Rev 835) to 2009-08-19 (DoY 231 Rev 836)

JEM-X 1 operations executed nominally.

2009-08-20 (DoY 232 Rev 836)

At 23:52, TC K0021 failed verification, parameter K5600 being 11 instead of the expected 1. Spacon decided to manually resend the KEDATA02 ED.

2009-08-21 (DoY 233 Rev 837)

At 00:19:15, during the manual re-uplink of the KEDATA02, the status of TC KU0014 was initially AFFECTED, then UNKNOWN, and finally UNVERIFIED. No additional action was taken and at 00:33:53, the instrument was back in Data-Taking.

¹² Data sampled (1 frame in 8)

8.2.5 OMC Operations

2009-08-15 (DoY 227, Rev 835)

Nothing to report.

2009-08-16 (DoY 228, Rev 835)

At 08:03:00, the OEM indicating the start of pointing 08350041 was lost, the pointing, however, proceeded nominally.

2009-08-17 (DoY 229, Rev 835)

At 00:52:05, a TRIGGER command was received from ISDC. This was then followed by 20 small exposures.

2009-08-18 (DoY 230, Rev 836) to 2009-08-20 (DoY 232, Rev 837)

Nothing to report.

2009-08-21 (DoY 233, Rev 837)

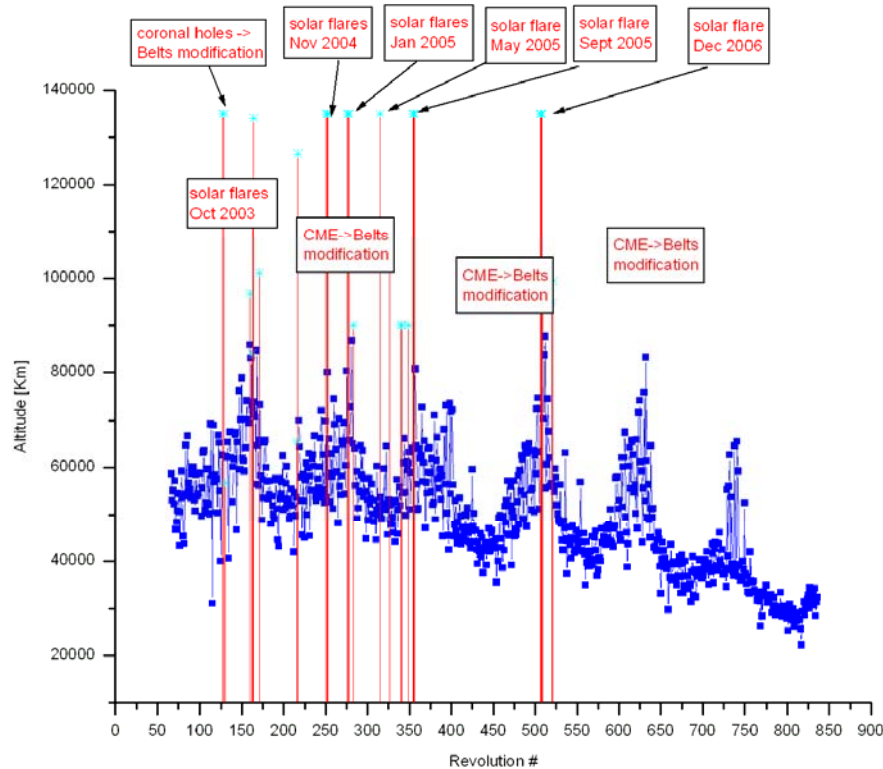
At 04:25, as a precautionary measure, due to earlier missed commands, the OMC pointing commands were re-iplinked. The impact was that pointing 08370007 was cut short from a planned 3200 to 2568 seconds.

On DoY 229 at 14:40:18 and DoY 232 at 14:26:10 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.2.6 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]
835	RAD_ENTR R 2009-08-17T14:40:10Z	17/08/2009 17:03:29	31365.0	17-Aug-2009 17:12:53	29151.03
836	RAD_EXIT R 2009-08-17T23:34:41Z	17/08/2009 22:27:37	>>32758.5	17-Aug-2009 23:22:53	47778.86
836	RAD_ENTR R 2009-08-20T14:26:06Z	20/08/2009 16:46:33	32305.4	20-Aug-2009 15:54:15	30727.52
837	RAD_EXIT R 2009-08-20T23:20:55Z	20/08/2009 22:35:53	>>34545.5	20-Aug-2009 22:14:15	47791.1

Reference

High radiation

Very small error vs reference (less than 10 minutes)

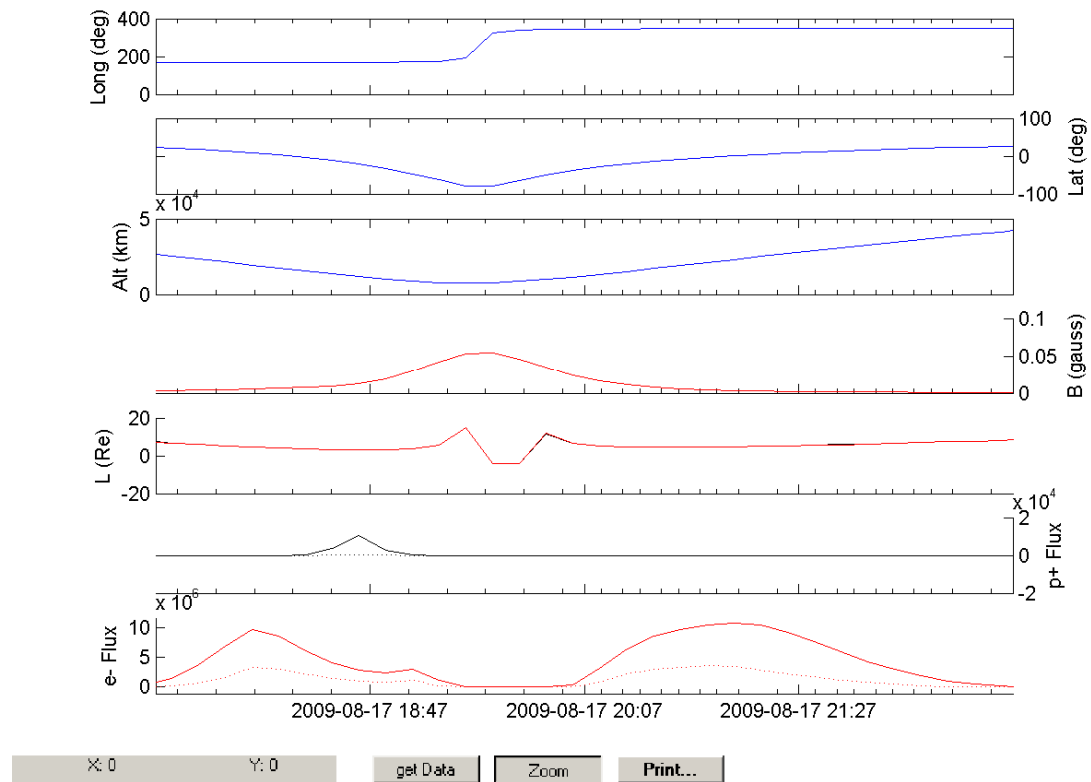
Small error vs reference (between 10 and 30 minutes)

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 Predicted Radiation Belt Passages

Rev 835



Rev 836

