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

INTEGRAL
Mission Report

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

No. 364
Week 37

14.09.09

Routine Phase

Prepared by: F. Schmidt (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 05.09.09 until 11.09.09 (both dates inclusive) and covers the revolutions 842 and 843.

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 hexagonal dither of Galactic Bulge region (RA 17:45:36.00, -28:56:00.0), a raster dither of the Galactic disk, l=+25 (RA 18:36:53.70, -07:03:19.4), a raster dither of the Galactic disk, l=-25 (RA 16:27:14.74, -48:57:19.9) and a raster dither of the Galactic Centre (RA 17:45:40.03, -29:00:28.1).

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.

Slews 08430048, 08430049, 08430050 and 08430051 were missed from the timeline.

The fuel consumption over the period between 05/09/2009 and 11/09/2009 was 0.1032 Kg. The remaining propellant is in the order of 132.5208 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

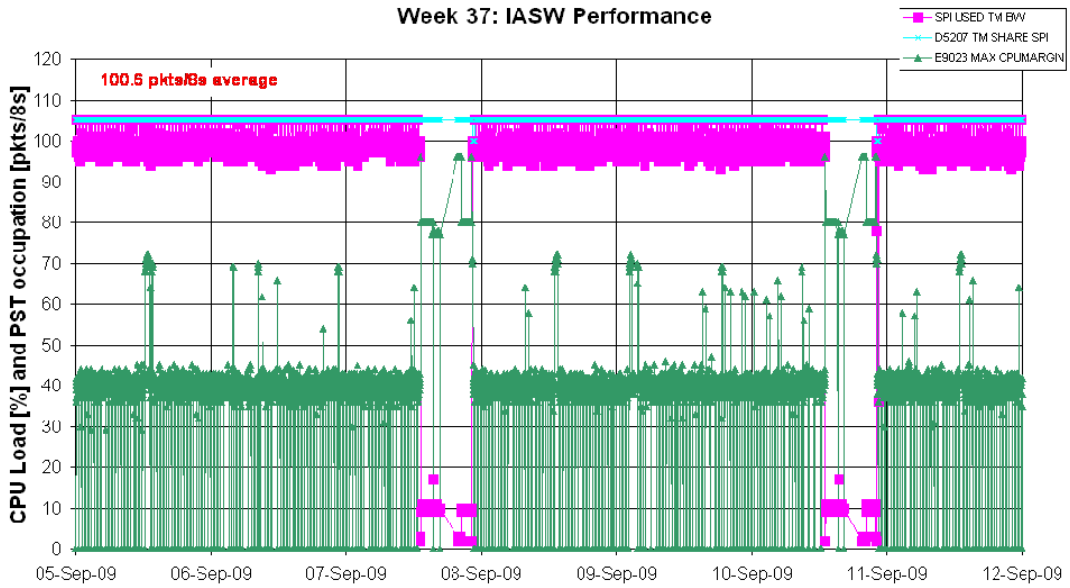
Following the 13th SPI annealing, which ended on 11/05/2009, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003); detector #17 (failed since 17/07/2004) and detector #5 (failed since 19/02/2009).

The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K+/-1K.

Eclipse operations for SPI are continued nominally during the reporting period.

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 100.6 packets/cycle.

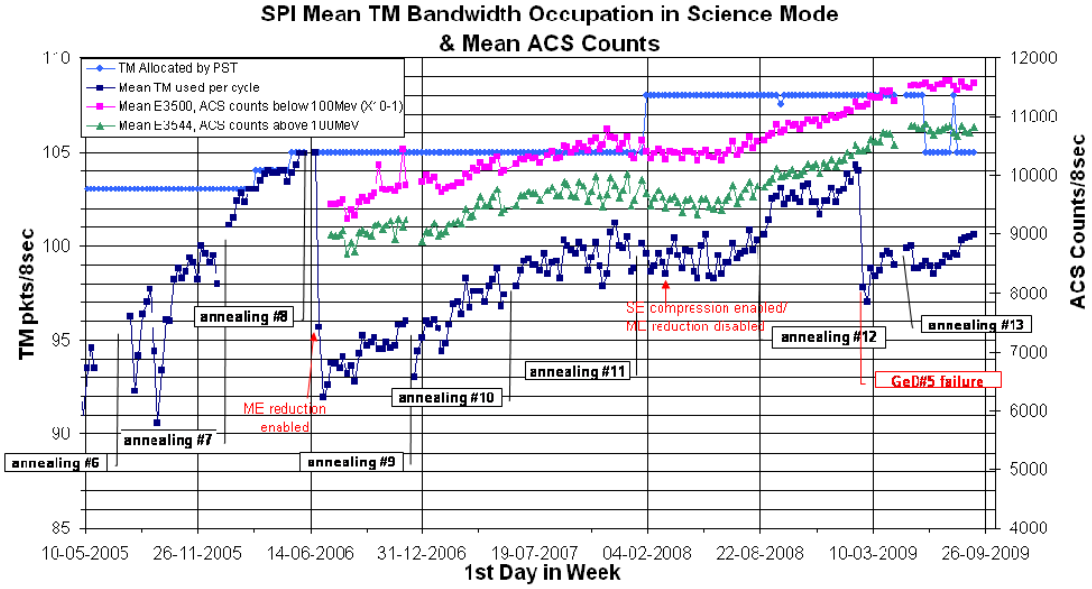
The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period[1]:



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

[1] Data sampled every 8th packet (64sec)

(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 8.3.2.

3.2.2 IBIS

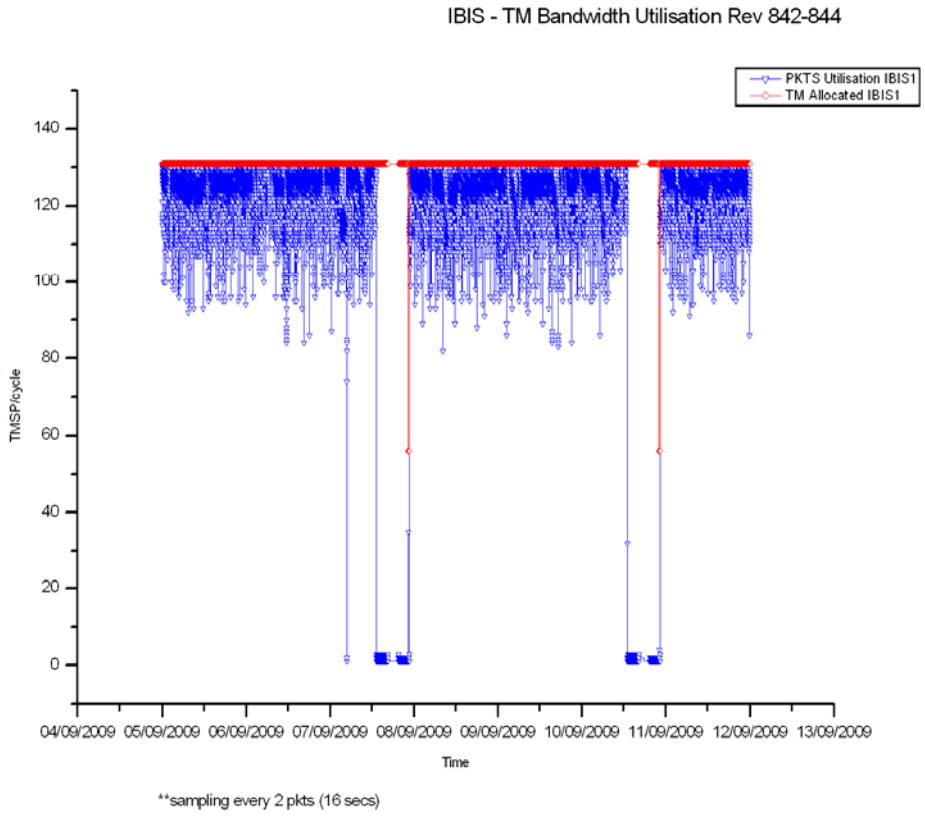
The overall status of IBIS is nominal.

Eclipse operations for IBIS are progressing nominally.

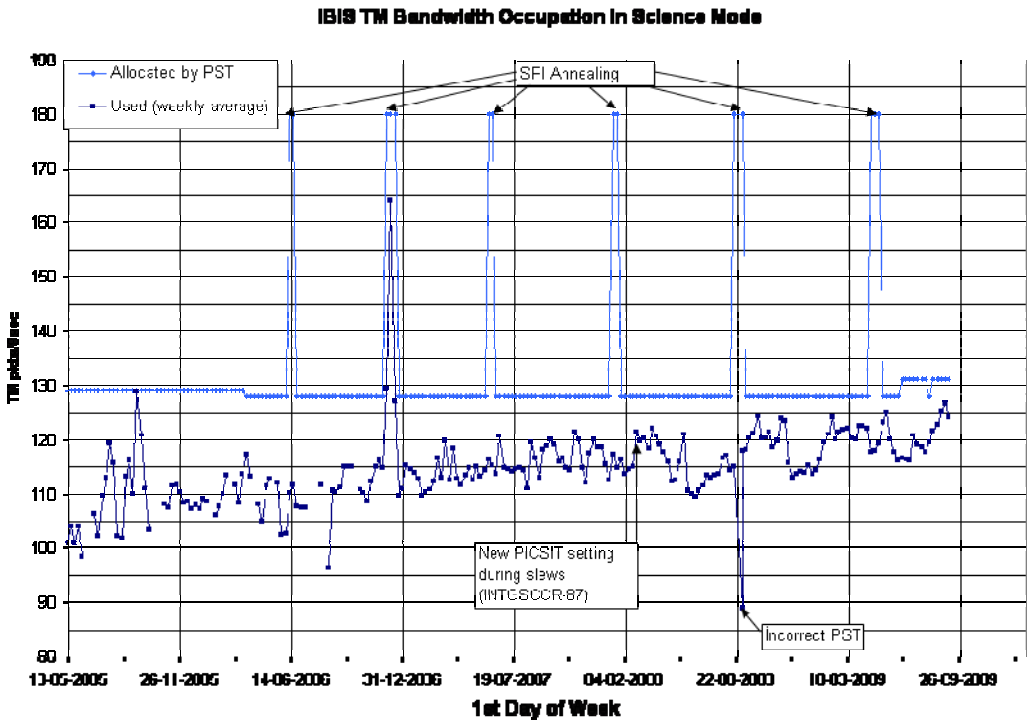
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 124.11 packets/cycle (down 2.43 on previous week)
- Percentage of TM cycles for which full bandwidth was used: 13.9%

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



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, 250 of the 253 planned science pointings were executed nominally, 3 were lost.

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.

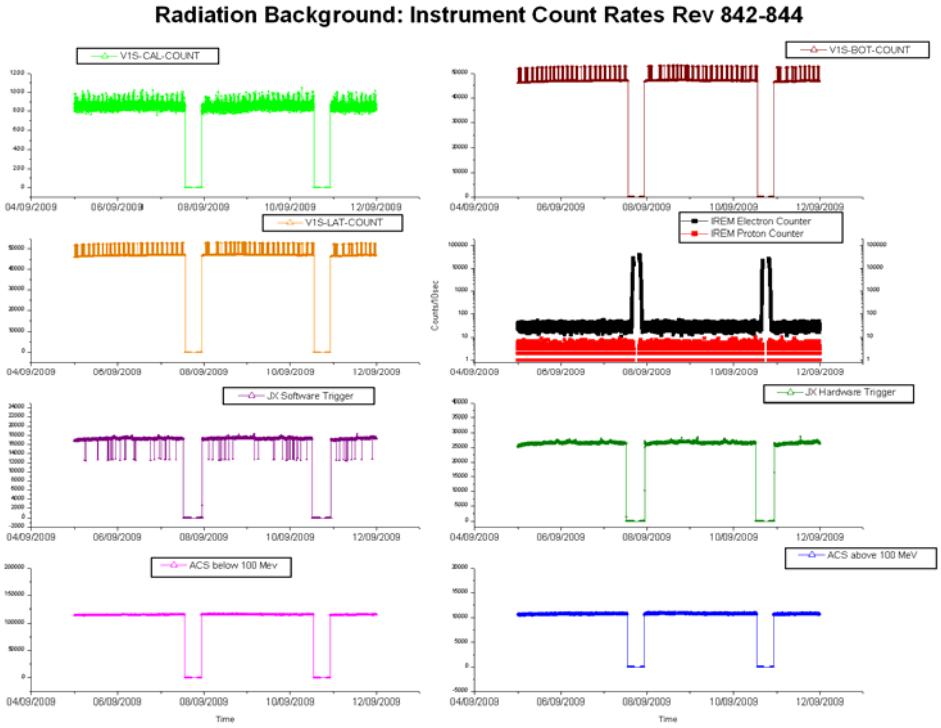
Solar Activity

The observation period was characterised by low solar activity. The sun remained 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.

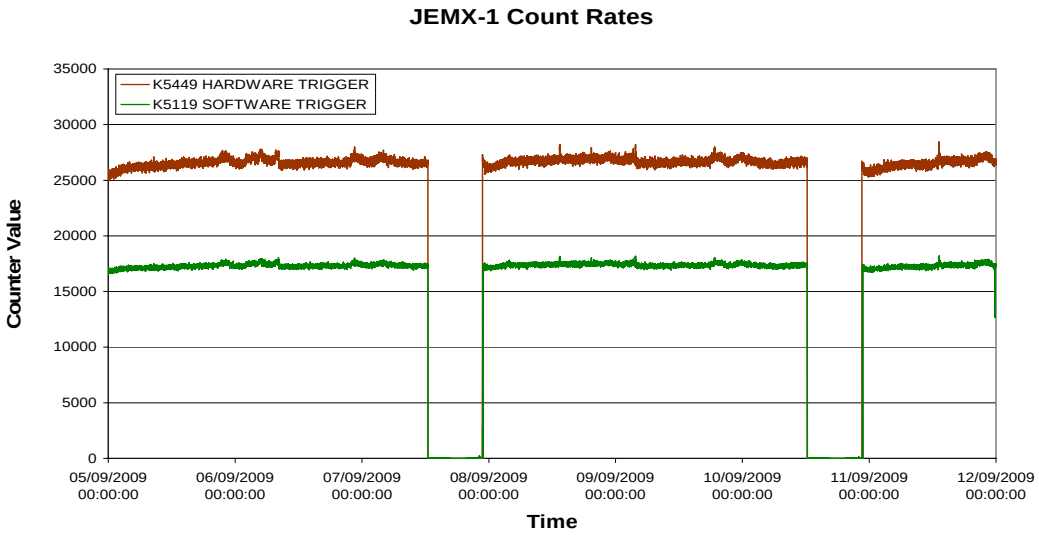
3.2.6 Radiation Backround

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 week[2]:



JEM-X Count Rates

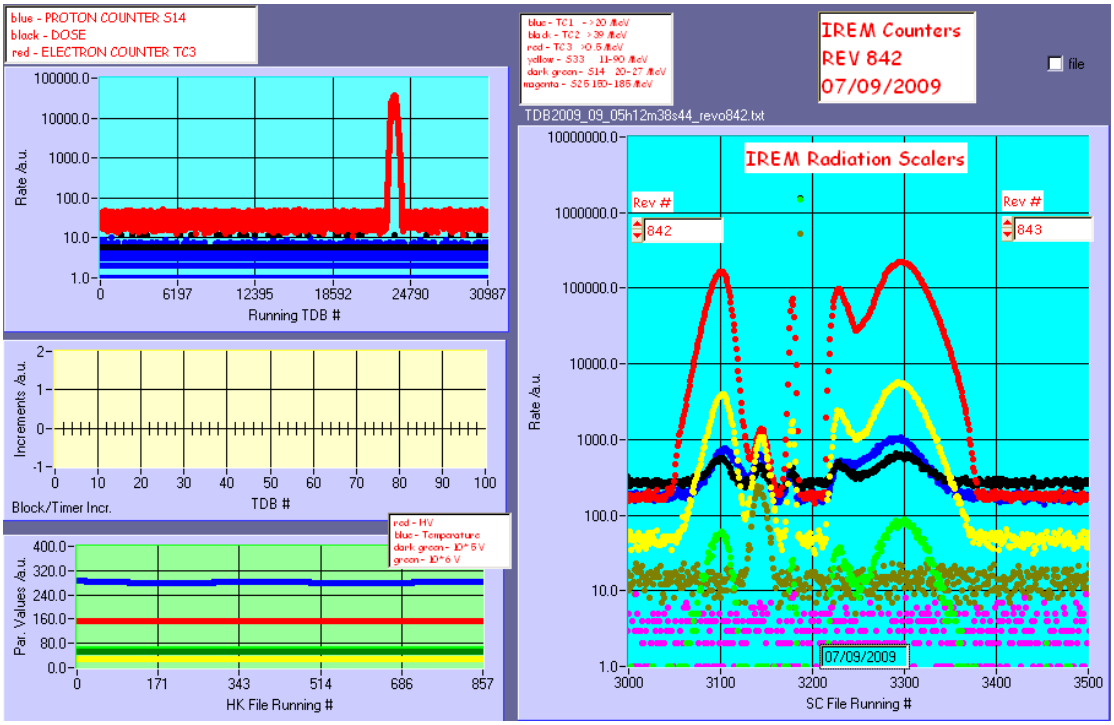
JEM-X count rates over the reporting period are displayed in the following graph[3].



[2] Data sampled every 6th packet (48sec)
[3] 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 842



Revolution 843 is not available

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 very good this week. There was one occasion 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 very good this week. There were two occasions of a TM drop VC0 and VC7 from DSS-27

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 851 and 852.

Observations have been planned for revolution 849.

New TSFs have been received for revolutions 845 and 846.

2. Observation status

No new ECS files have been received, the last processed was for revolution 829.

3. ISOC Science Data Archive

No news.

4. ISOC system

Work is ongoing on ISOC software version V23.1.

5. Problems

No new problems.

5 Special Events

6 Anomalies

The following anomaly occurred this week:

AR id	Date Created	Subject	Segment	Status
INT-3074	2009-09-09	FD Attitude Determination Failure	FDS	Pending

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, 05/09/2009 – 11/09/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 174 Open Loop Slews, 93 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

Slews 08430048, 08430049, 08430050 and 08430051 were missed from the timeline.

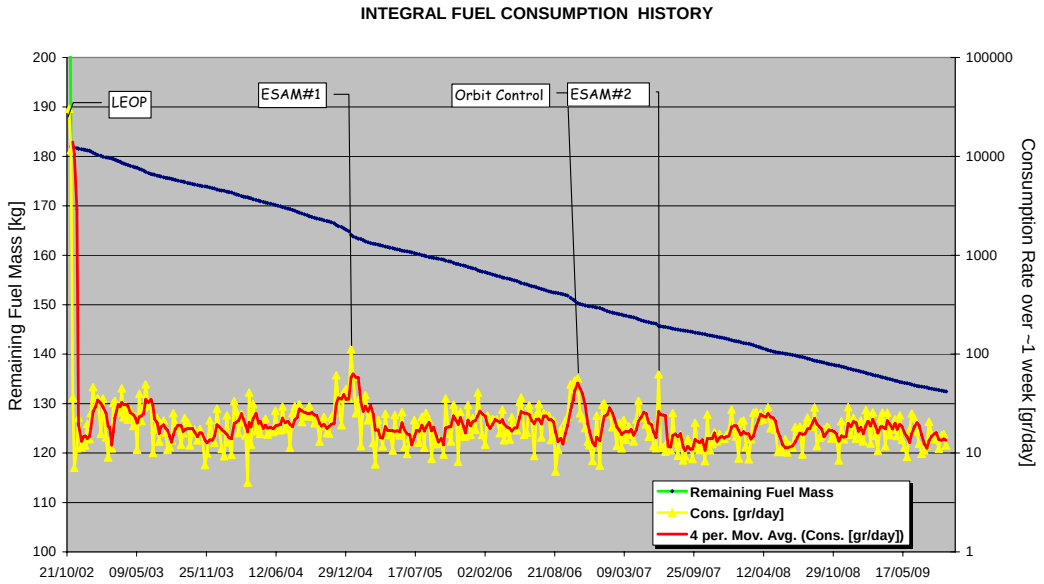
The OTF was not reached for PID 08420007, 08430048, 08430049, 08430050 and 08430051.

Orbit Control

No update.

Fuel consumption

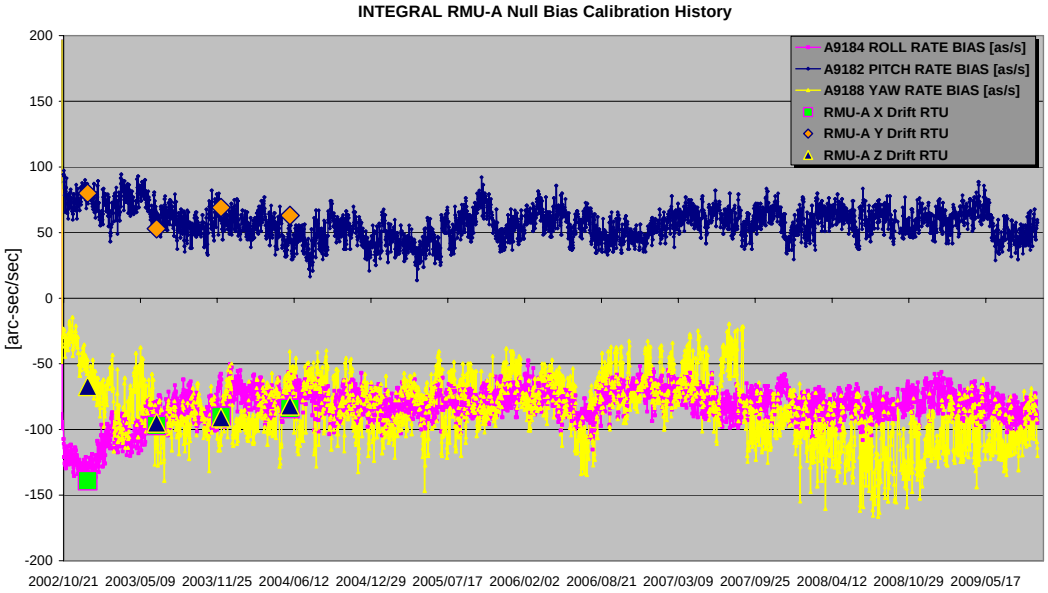
The fuel consumption (total, grams per day) over the period between 01/11/2002 and 11/09/2009 is reported in the plot below.



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 11/09/2009 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:

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05/09/2009 (Day of Year 248, Revolution 842)

- IMU1 switched ON during the stable pointing of PID 08420007 (01:39:00Z). A manual mapping was commanded and the parameters for slew 08420008 manually updated (spacontool).

No impact on the Timeline.

OTF was not reached for PID 08420007.

06/09/2009 (Day of Year 249, Revolution 842)

Nothing to report

07/09/2009 (Day of Year 250, Revolution 842 to 843)

Nothing to report

08/09/2009 (Day of Year 251, Revolution 843)

Nothing to report

09/09/2009 (Day of Year 252, Revolution 843)

- FDS failed the automatic update of PREQ 08430048 (00:03Z). The subsequent attempt by the SPACON to update it manually failed as well, since the attitude determination error was greater than the set up threshold.

The attitude recovery was performed by FD, by performing a manual slew from attitude 08430047 to 08430051.

Slews 08430048, 08430049, 08430050 and 08430051 were not performed via Timeline. Neither the OTF was reached for their corresponding pointings.

10/09/2009 (Day of Year 253, Revolution 843 to 844)

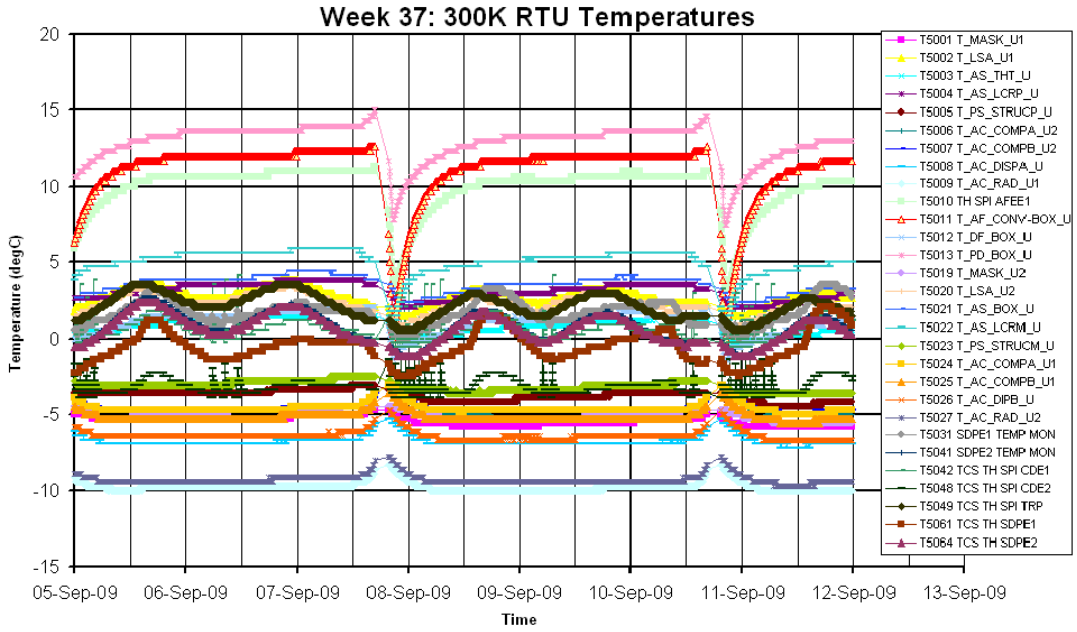
Nothing to report

11/09/2009 (Day of Year 254, Revolution 844)

Nothing to report

8.2.2 SPI Operations

Unit Temperatures: All the equipment temperatures are inside the operational limits. The following plot shows their evolution during the reporting period. The temperature recovery after eclipse was nominal:



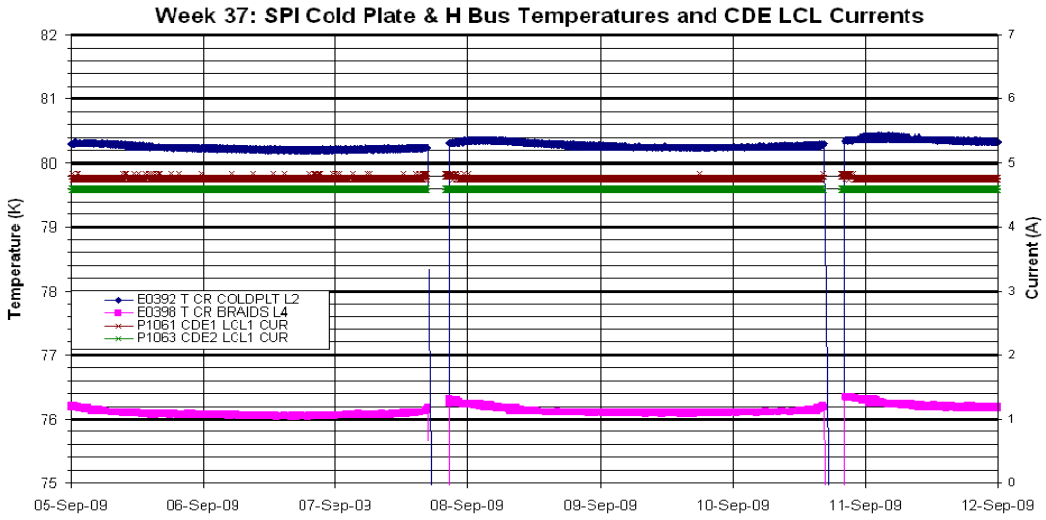
Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

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 = 4.77A
- CDE2 LCL Current = 4.58A

The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period[4]:

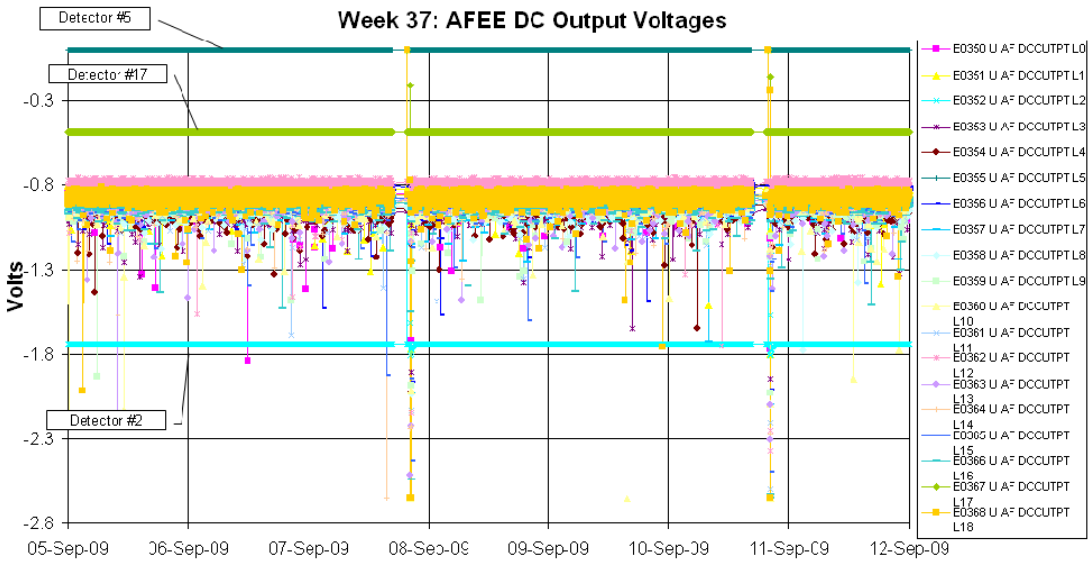
[4] Data sampled every 8th packet (64sec)



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).

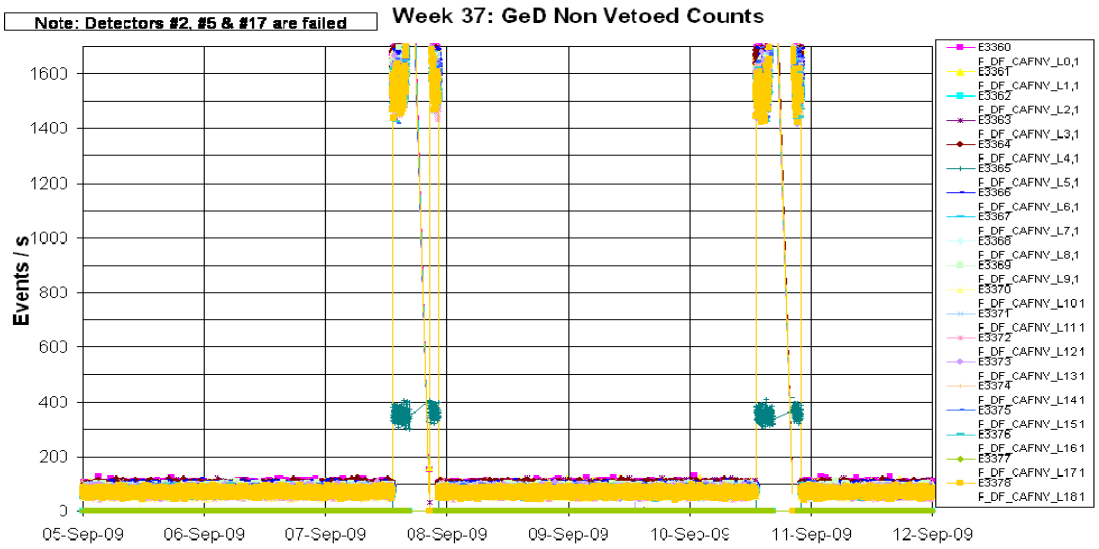
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

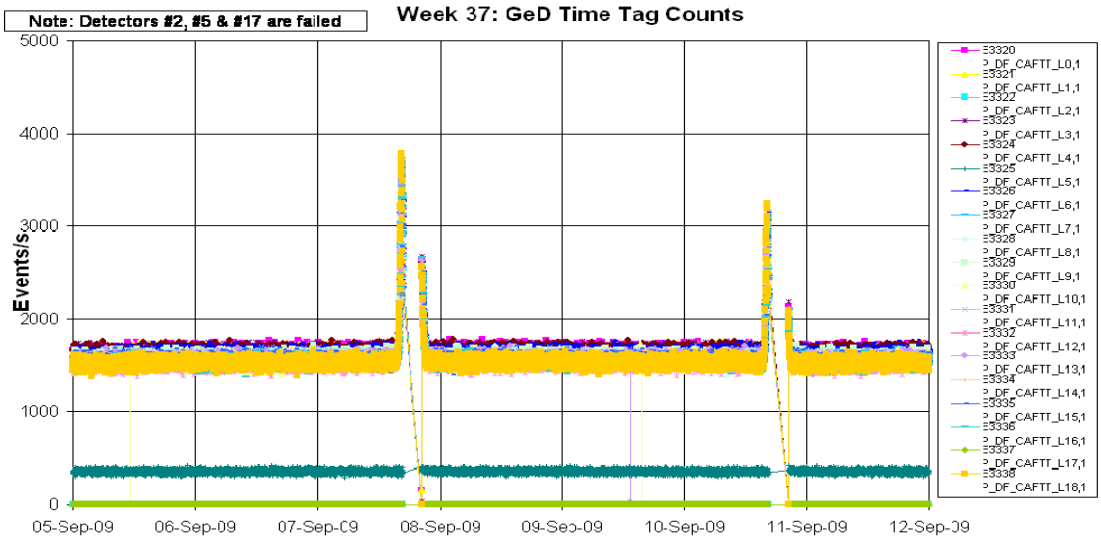
AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period[5]. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of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

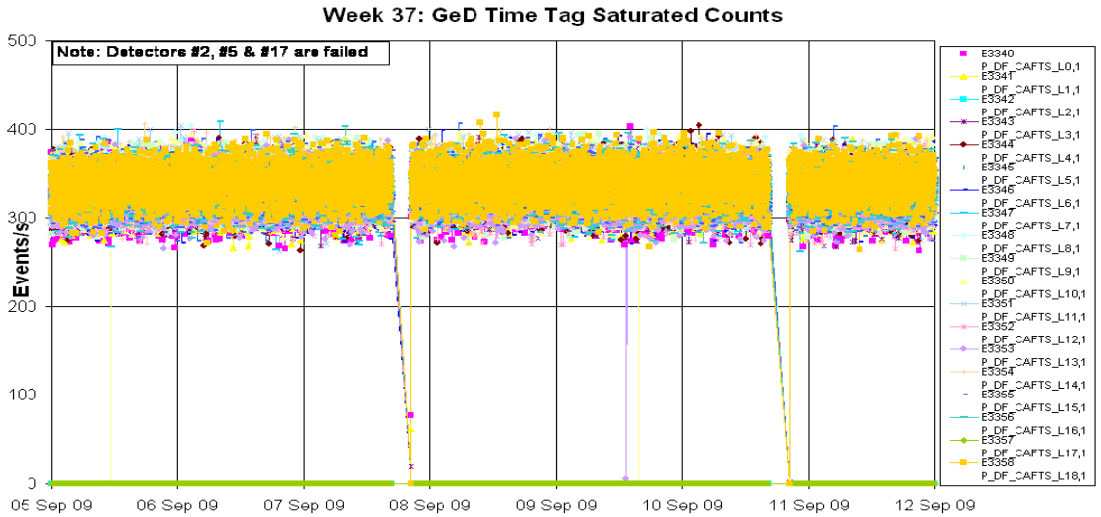


[5] Data sampled every 8th packet (64sec)

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 period[6].

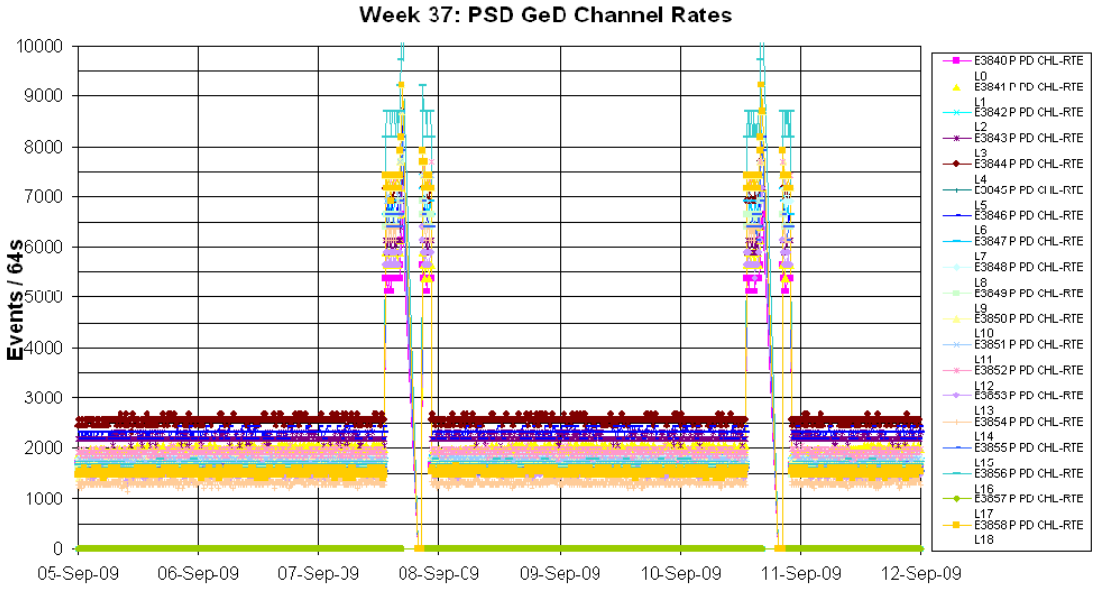






[6] Data sampled every 8th packet (64sec)

PSD: The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period[7]:



Event Log:

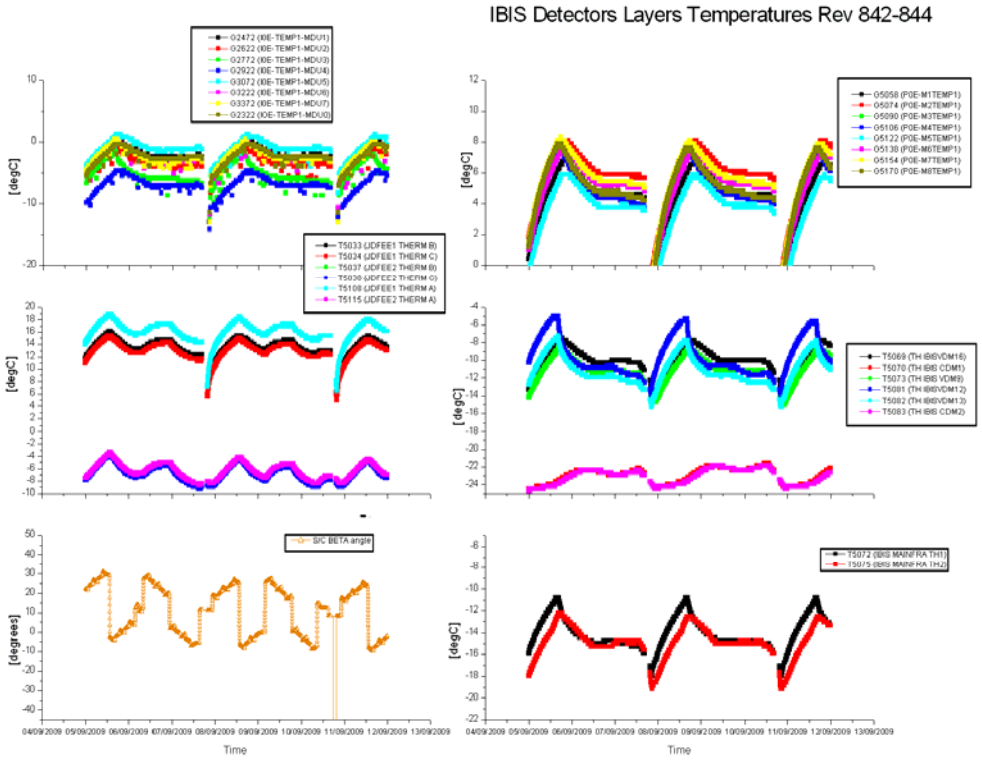
The following non-nominal events occurred with SPI over the reporting period:

- On 2009-09-05 at 15:06:11Z OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED was received with parameter E9780 (DETECTOR ID) = 15. As it was a single occurrence, no action was taken.
- On 2009-09-06 at 22:09Z TM parameter E3179 went OOL. This is the ACS FEE temperature status #15. The TC sequence ES1831 was sent at 22:16:56Z to report the ACS HK TM and this parameter returned within limits.
- On 2009-09-09 at 09:16:25Z and again on 2009-09-11 at 17:05:21Z TM parameter E1296 went OOL (value = ERROR STATE). This is the ACS ISB response parity error. As in each case it returned within limits of its own accord at the next TM cycle, no action was taken.

[7] Data sampled every 8th packet (64sec)

8.2.3 IBIS Operations

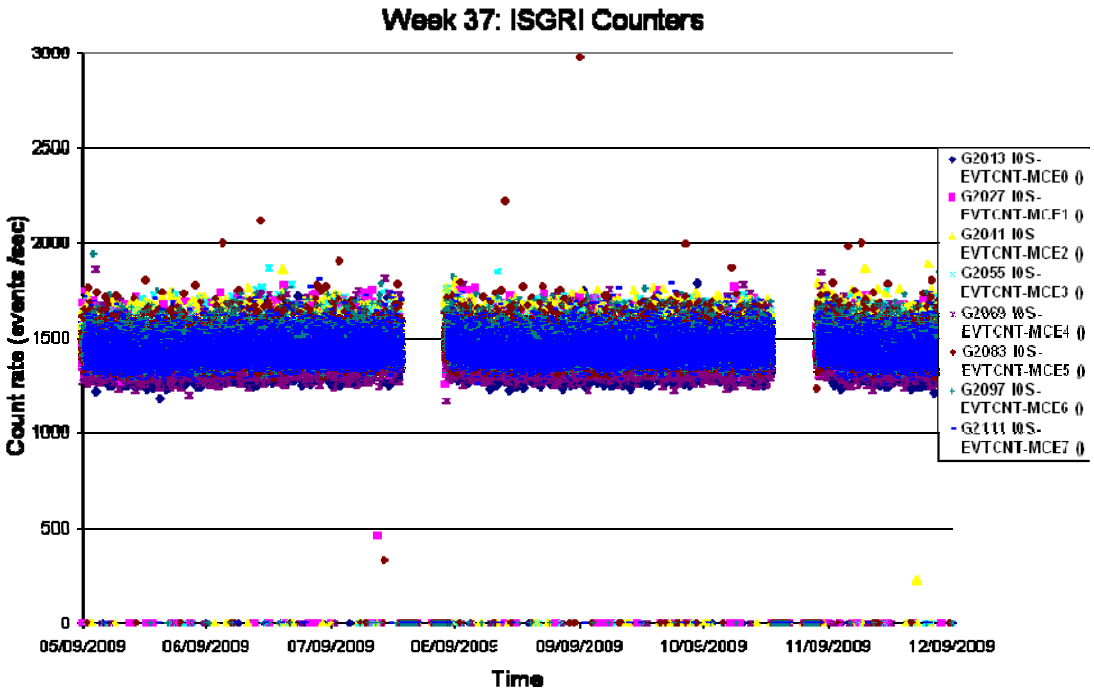
Unit Temperatures: All the equipment temperatures were inside the operational limits throughout the week. The following plot shows selected IBIS temperatures, along with those of the JEM-X DFEE and the S/C beta angle for comparison. The temperature recovery of the units after eclipse was nominal.



**sampling every 8 pkts (64 secs)

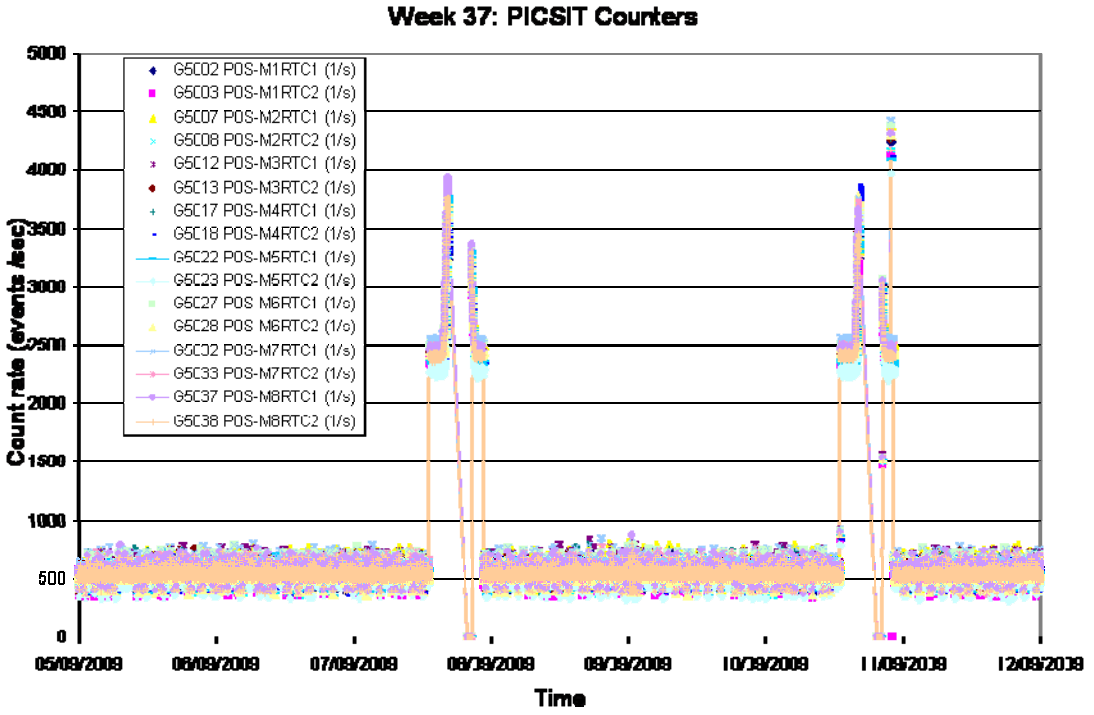
ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week[8]:



PICsIT

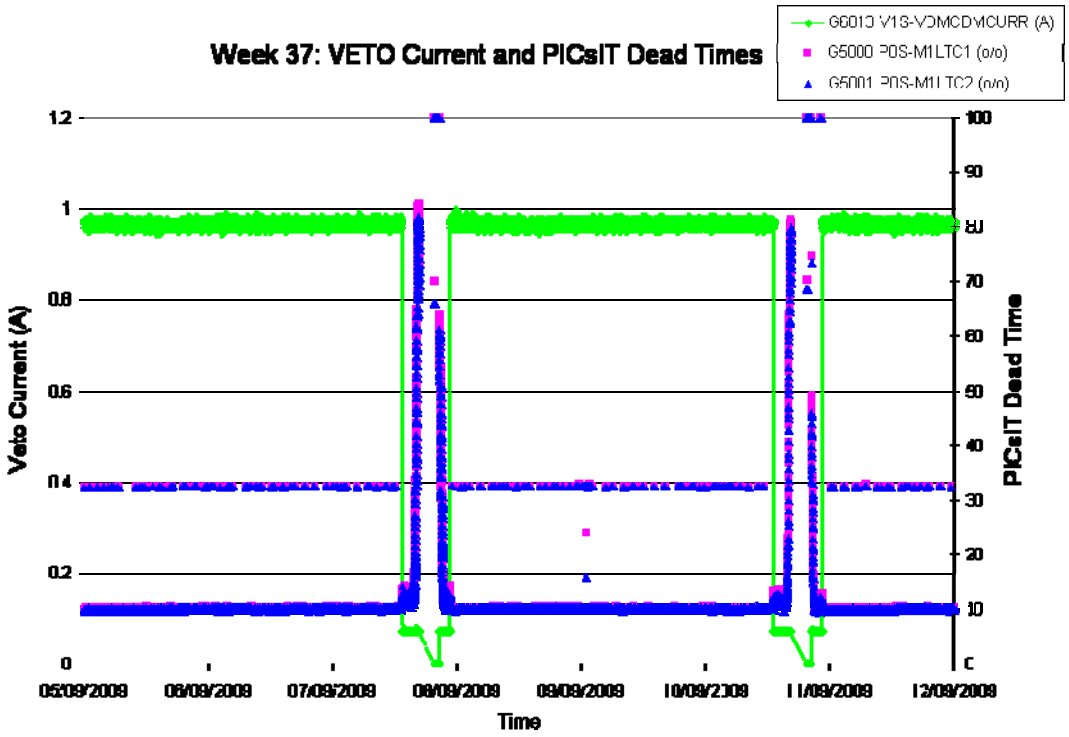
The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week[9]:



[8] Data sampled every 4th packet (32sec)
[9] 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 week[10]:



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.

2009-09-05 (DOY 248, Rev. 842) to 2009-09-06 (DOY 249, Rev. 842)

IBIS operations executed nominally.

2009-09-07 (DOY 250, Rev. 842-843)

At 03:36Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 04:55:15Z FCP_IBIS1_0312
- 04:57:13Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

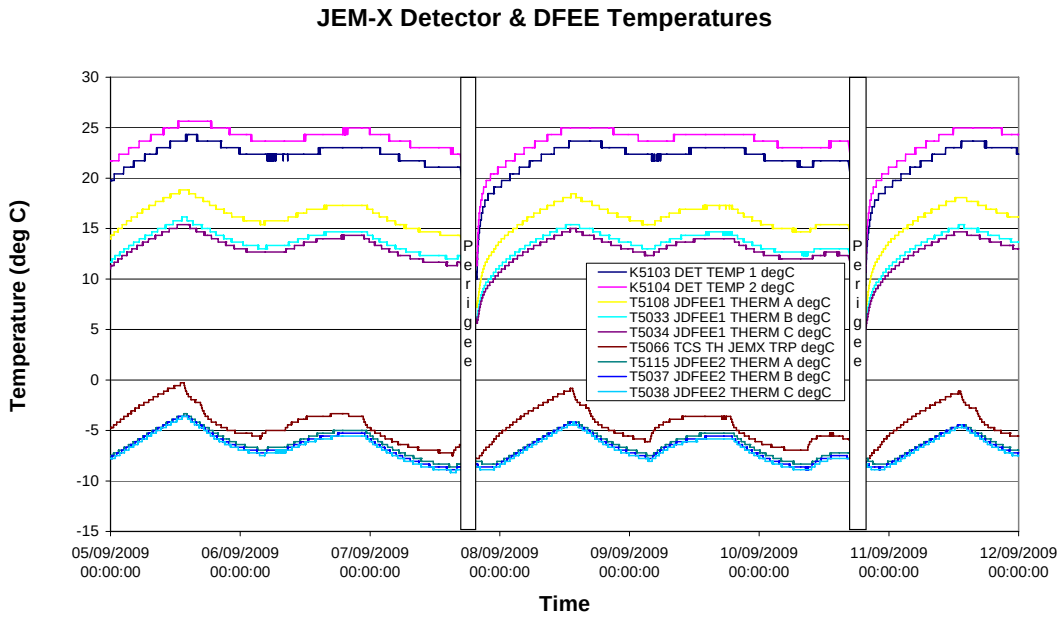
2009-09-08 (DOY 251, Rev. 843) to 2009-09-11 (DOY 254, Rev. 844)

IBIS operations executed nominally.

[10] 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 graph[11].



JEM-X Daily Report

2009-09-05 (DoY 248 Rev 842) to 2009-09-06 (DoY 249 Rev 842)

JEM-X 1 operations executed nominally.

2009-09-07 (DoY 250 Rev 842-843)

From 19:45:47 to 19:46:11 TM parameter KD5380D indicated a false status. No action was taken, and there was no impact.

At 22:58:34 TCs K0021 & KU0014 terminated with an `UNKOWN` status.

2009-09-08 (DoY 251 Rev 843)

At 03:32:46, TC K0021 terminated with an `UNCERTAIN-FAILED` Status. No action was taken, and there was no impact.

2009-09-09 (DoY 252 Rev 843)

JEM-X 1 operations executed nominally.

2009-09-10 (DoY 253 Rev 843-844)

[11] Data sampled (1 frame in 8)

At 12:17:36 TC KU0014 terminated with a status AFFECTED, at 12:17:44 this changed to UNVERIFIED. No action was taken, and there was no impact.

From 19:40:35 to 19:40:59 TM parameter KD5380D indicated a false status. No action was taken, and there was no impact.

2009-09-11 (DoY 254 Rev 844)

JEM-X 1 operations executed nominally.

8.2.5 OMC Operations

2009-09-05 (DoY 248, Rev 842) to 2009-09-08 (DoY 251, Rev 843)

Nothing to report.

2009-09-09 (DoY 252, Rev 843)

At 00:06:00, a FD problem, forced a suspension of the Timeline. A recovery was performed, and at 01:40, the spacecraft was manually manoeuvred to the attitude for pointing 08430051. The timeline was restored at 02:01. The impact was the loss of pointings 08430048, 08430049 & 08430050.

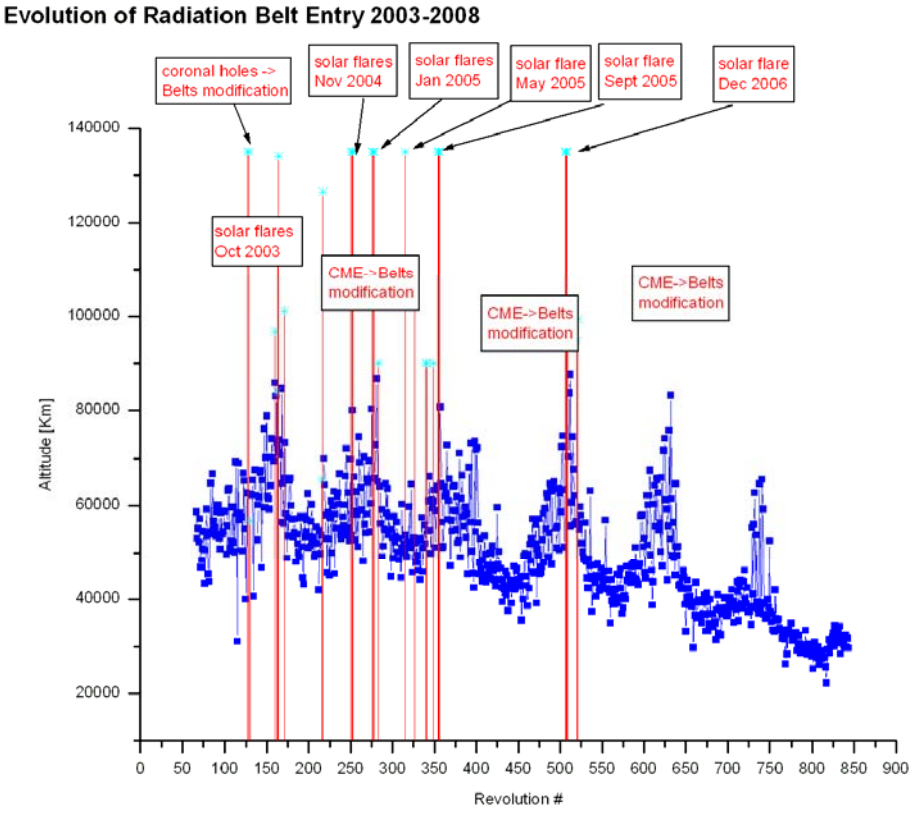
2009-09-10 (DoY 253, Rev 843) to 2009-09-11 (DoY 254, Rev 844)

Nothing to report.

On DoY 250 at 13:18:59 and DoY 253 at 13:06:51 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



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]
842	RAD_ENTR R 2009-09-07T13:18:58Z	07/09/2009 15:40:26	31715.5	07-Sep-2009 15:42:02	29492.74
843	RAD_EXIT R 2009-09-07T22:13:05Z	07/09/2009 21:17:30	41477.6	07-Sep-2009 21:52:02	47571.84
843	RAD_ENTR R 2009-09-10T13:06:50Z	10/09/2009 15:38:02	29666.6	10-Sep-2009 15:29:25	30243.63
844	RAD_EXIT R 2009-09-10T22:00:09Z	10/09/2009 20:58:10	39846.5	10-Sep-2009 21:39:25	47029.95

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

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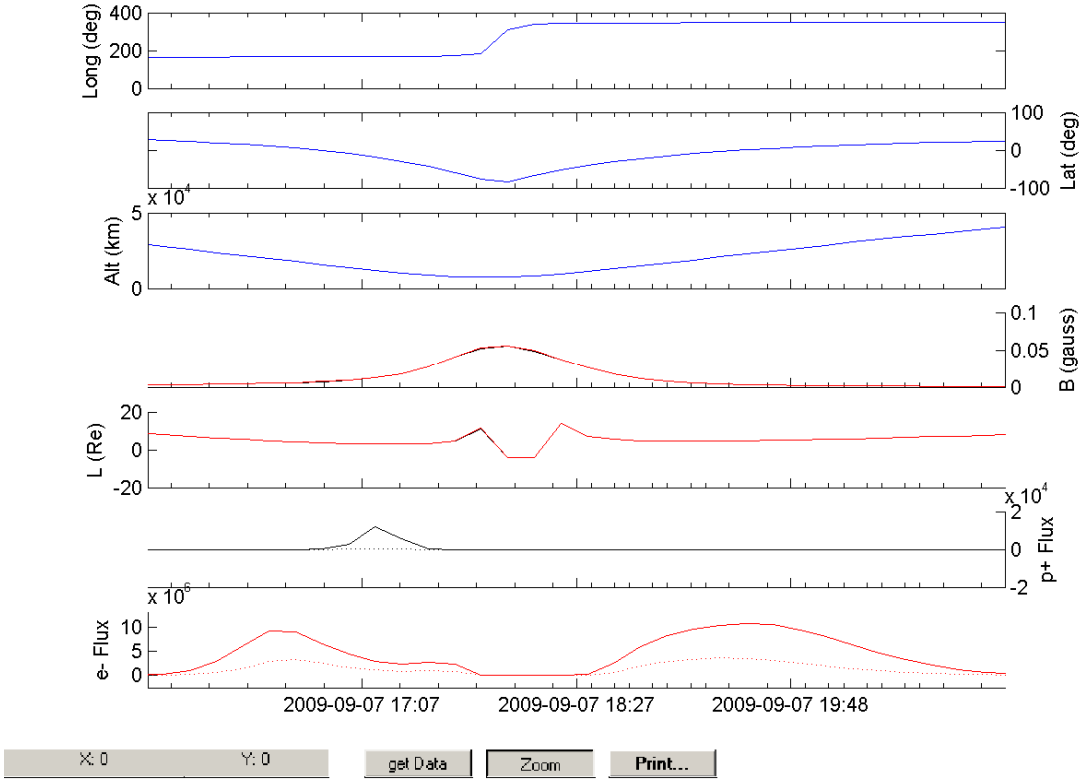

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