

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 354
Week 27
06.07.09
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 27.06.09 until 03.07.09 (both dates inclusive) and covers the revolutions 818, 819 and 820.

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 47 Tuc and SMC (RA 00:53:55.20, DEC -72:26:42.0), a raster dither of the Virgo Cluster (RA 12:26:32.10, +12:43:24.0) and a hexagonal dither of the Coma Cluster (RA 12:59:48.70, +27:58:50.0).

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 TL, during the observation period.

The fuel consumption over the period between 27/06/2009 and 03/07/2009 was 0.0748 Kg. The remaining propellant is in the order of 133.4930 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

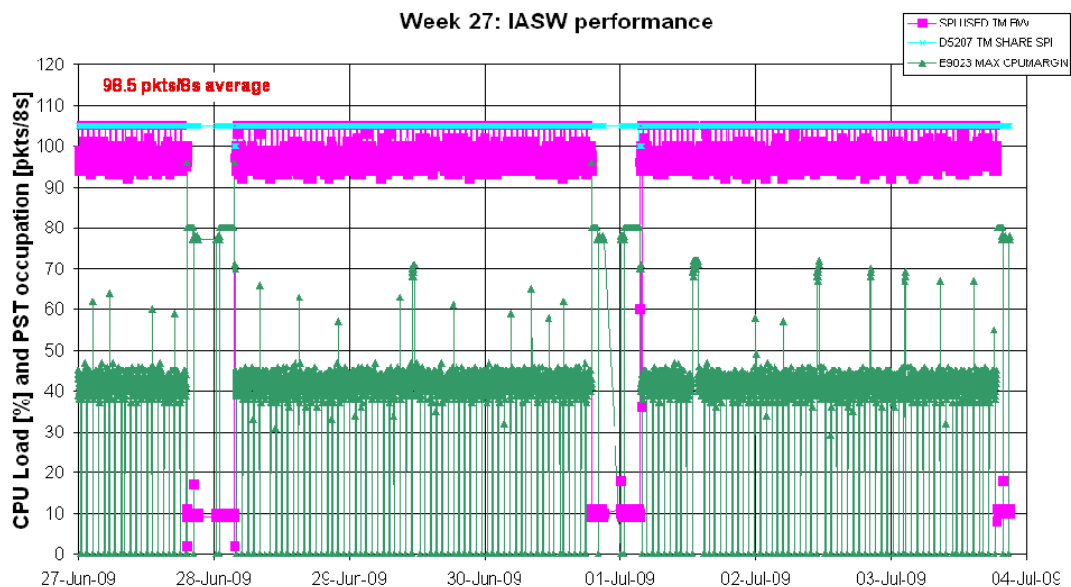
3.2.1 SPI

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.

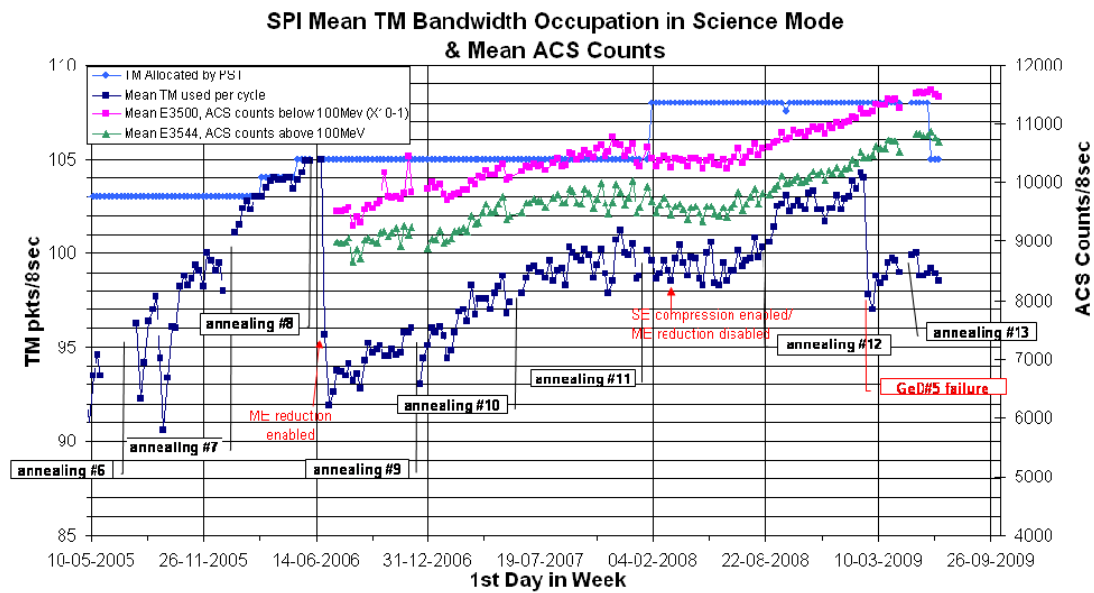
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle and the average telemetry occupation was 98.5 packets/cycle.

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.

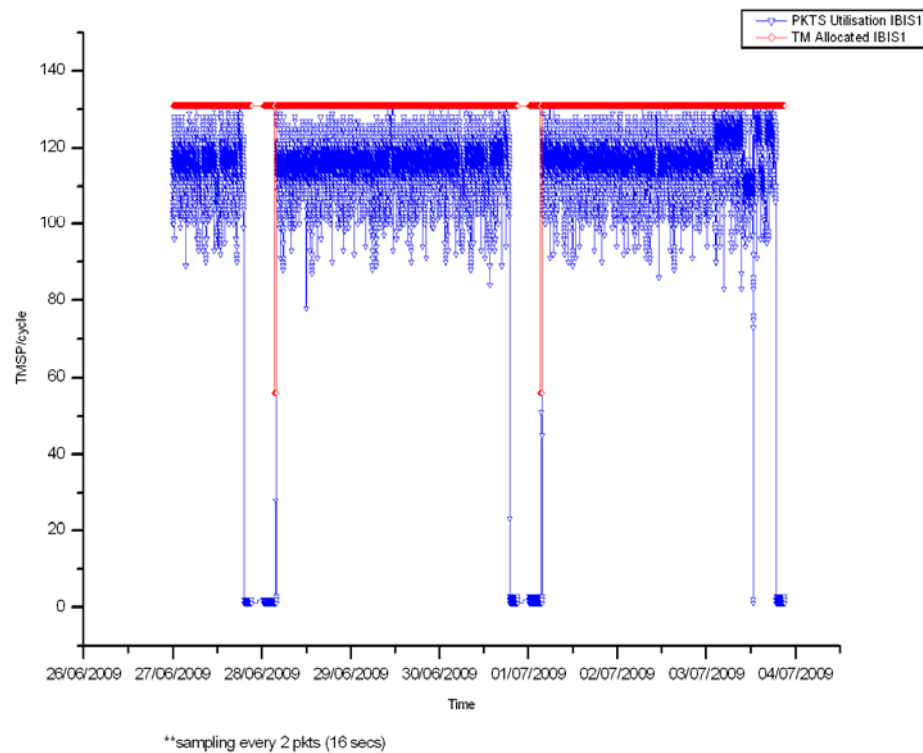
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 116.09 packets/cycle (down 0.31 on previous week)
- Percentage of TM cycles for which bandwidth usage was 131 packets/cycle: 0.21%

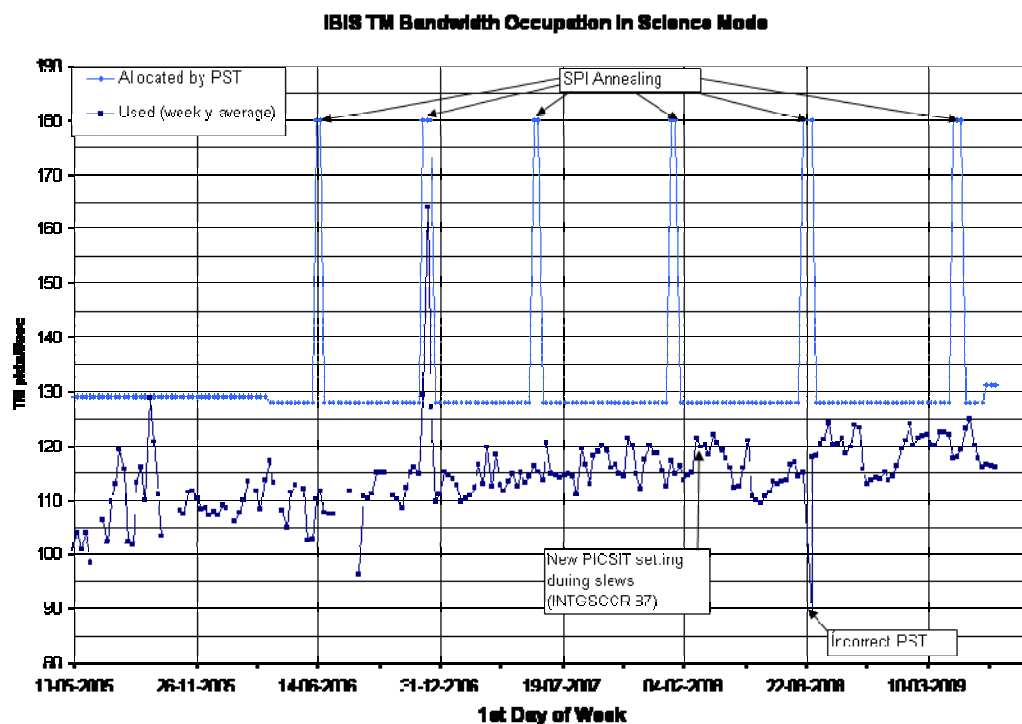
The plot below shows the IBIS TM utilisation during the reporting period² :

² Data sampled every 2nd packet (16sec)

IBIS - TM Bandwidth Utilisation Rev 818-820



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, all of the 138 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

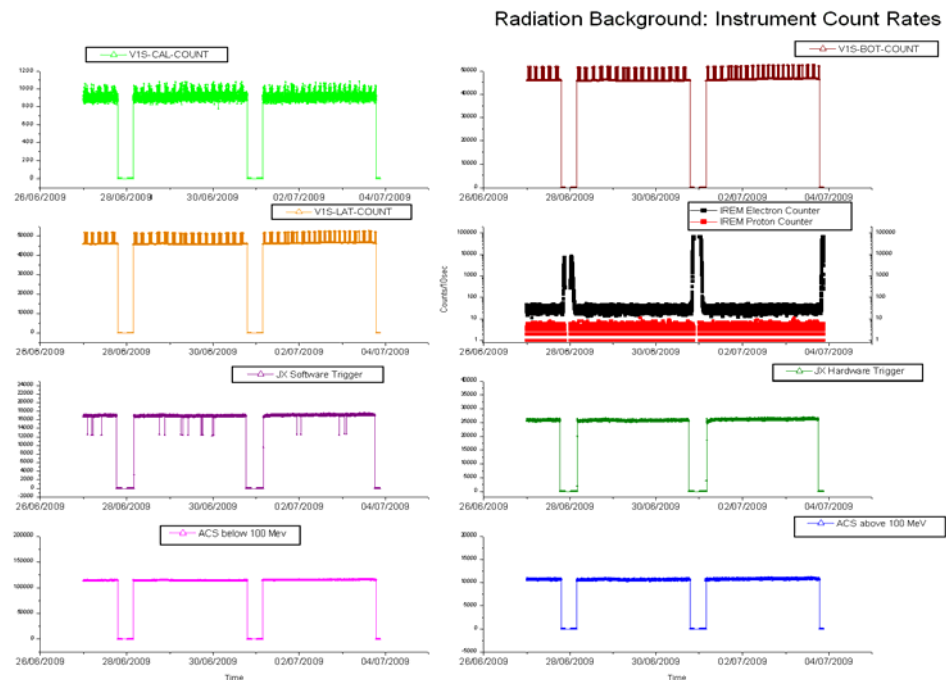
The observation period was characterised by low solar activity. At the start of the week, the sun was blank. A small sun-spot appeared on the 30th June, but disappeared before it could be allocated a number. The risk of solar flares was very low.



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

3.2.6 Radiation Background

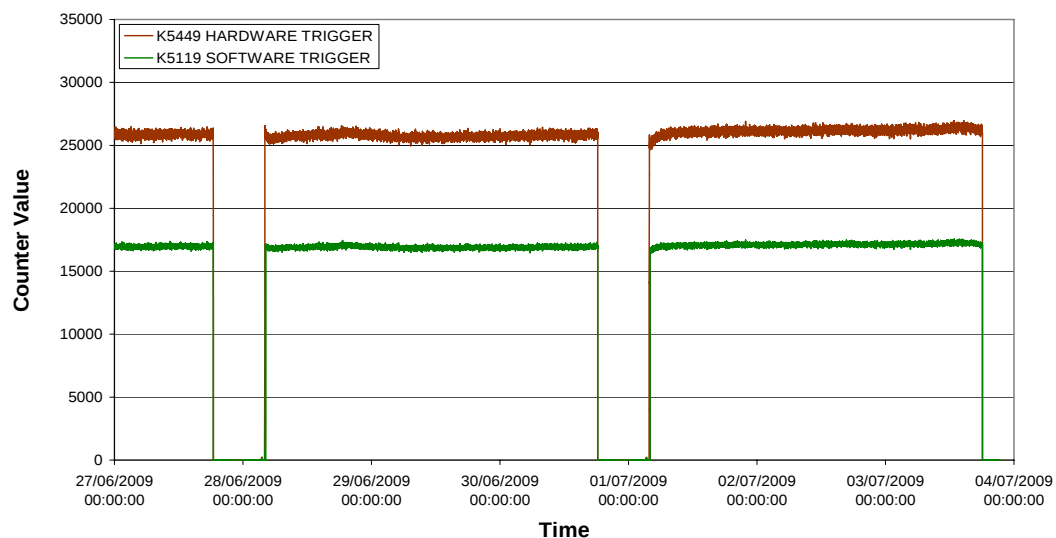
The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week³ :



JEM-X Count Rates

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

JEMX-1 Count Rates

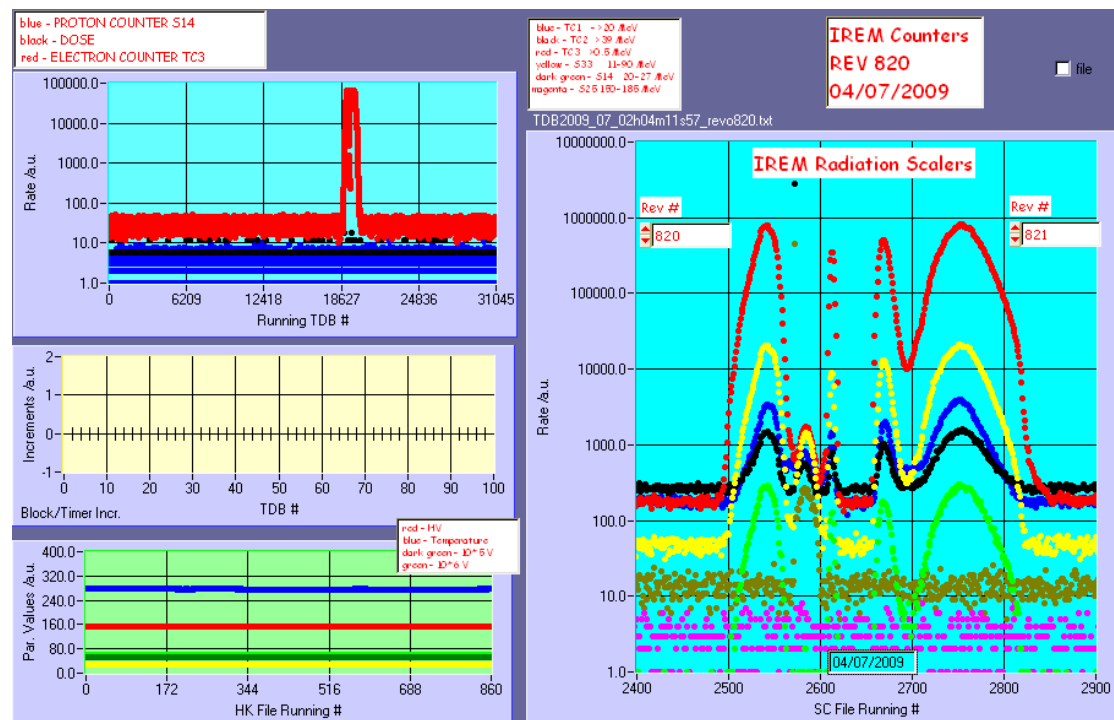
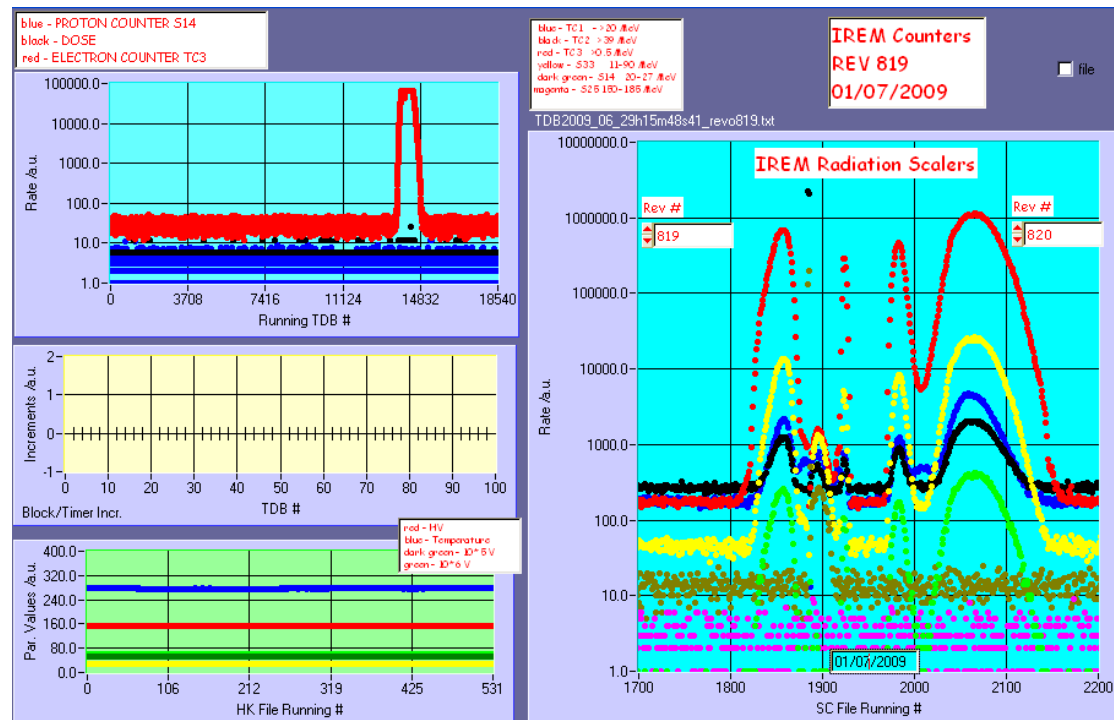


³ Data sampled every 6th packet (48sec)

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 818 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 were several occasions on DOY 181 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 7 occasions of bad frames and 8 occasions of a TM drop VC0 and VC7 from Redu. There was no impact on T/L operations.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

A new PSF has been received and observations have been planned for revolution 828.

New TSFs have been received for revolutions 821-823.

2. Observation status

New ECS files have been received for revolutions 804 and 805.

3. ISOC Science Data Archive

There have been intermittent problems in accessing the Archive remotely or via the GAIO interface used, e.g., by the grid.

Transfer of raw TM data from MOC is mostly working well, but a few issues have been found in careful checking.

4. ISOC system

A new virtual Web server (sharing a machine with other projects) has been mostly set up and appears to work well. The switch is pending on some questions to be settled this week.

5. Problems

On 3 July at ~23:20, ESAC suffered an unforeseen complete power cut, also affecting ISOC operations. Luckily, this was after the AO deadline.

5 Special Events

6 Anomalies

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

AR id	Date Created	Subject	Segment	Status
INT_SC-262	2009-07-02	Spurious Switch Off of SPI Camera Heater B due to SEU on PPDU-B	Spacecraft	Pending
INT_SC-261	2009-06-29	RW3 Heater Spurious Switch-off	Spacecraft	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, 27/06/2009 – 03/07/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 87 Open Loop Slews, 60 Closed Loop Slews and 4 Momentum Biases were executed (as reported by ACC OEM).

Slews 08200011 and 08200042 were missed from the TL.

Orbit Control

No update.

Fuel consumption

No update

The RMU-A null bias calibration

No update

27/06/2009 (Day of Year 178, Revolution 818)

Nothing to report

28/06/2009 (Day of Year 179, Revolution 818 to 819)

Nothing to report

29/06/2009 (Day of Year 180, Revolution 819)

Nothing to report

30/06/2009 (Day of Year 181, Revolution 819)

Nothing to report

01/07/2009 (Day of Year 182, Revolution 819 to 820)

FD update failed for slew 08200011. In the Timeline, PREQ 08200011 was planned as a CSL. Nevertheless, the lack of stars in the STR FoV overlap made it necessary to perform it as an OSL. FD generated then the manual OSL 0802_0500_M.OSL to achieve the attitude of PREQ 08200011.

After 0820_0500_M.OSL was completed a mapping was commanded and the parameters for slew 08200012 updated.

Slew 08200011 was missed from the Timeline.

02/07/2009 (Day of Year 183, Revolution 820)

Execution of OSL 08200042 failed: "A8119 failed On Board reception" due to a TC drop. The SPACON regenerated it manually via FD spacontool (slew from PID 08200041 to PID 08200042) and, once its execution was completed, updated the parameters for the next slew (08200043) in the Timeline.

Slew 08200042 was missed from the Timeline

03/07/2009 (Day of Year 184, Revolution 820)

Nothing to report

8.2.2 SPI Operations

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

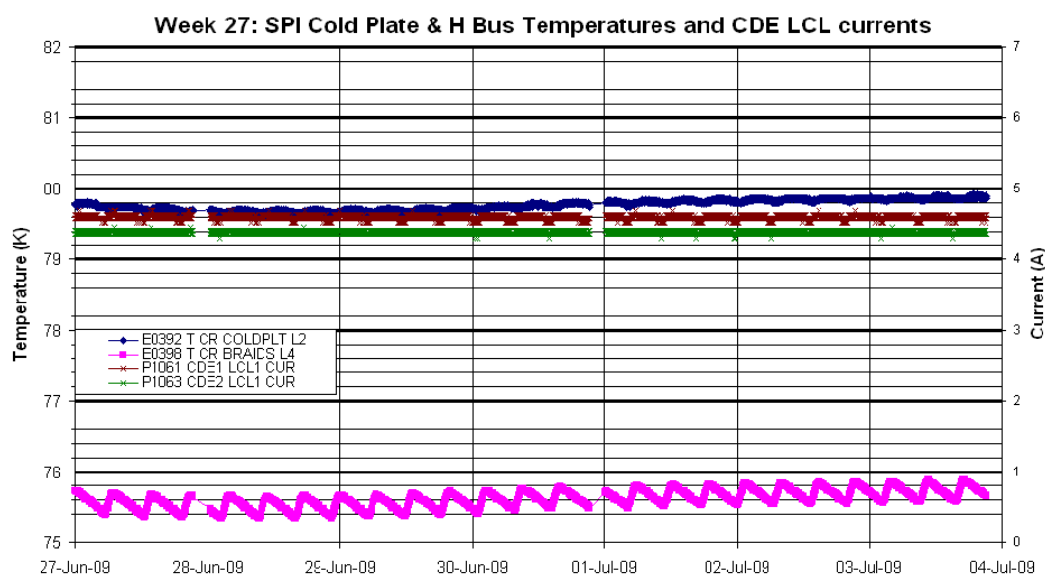
Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

The stroke of all four compressors was set to 39 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.59A
- CDE2 LCL Current = 4.38A

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:

⁵ Data sampled every 8th packet (64sec)

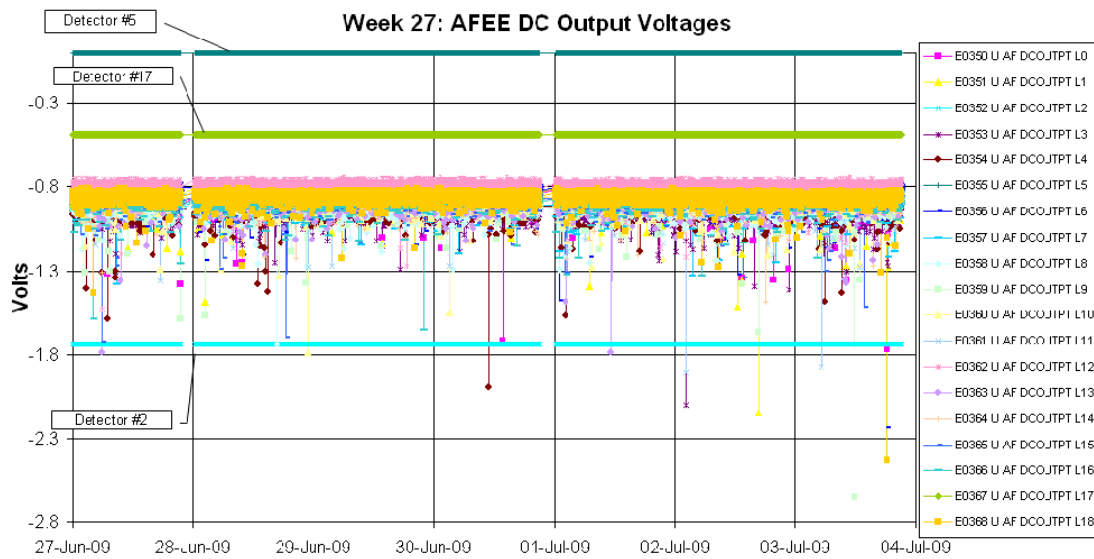


DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

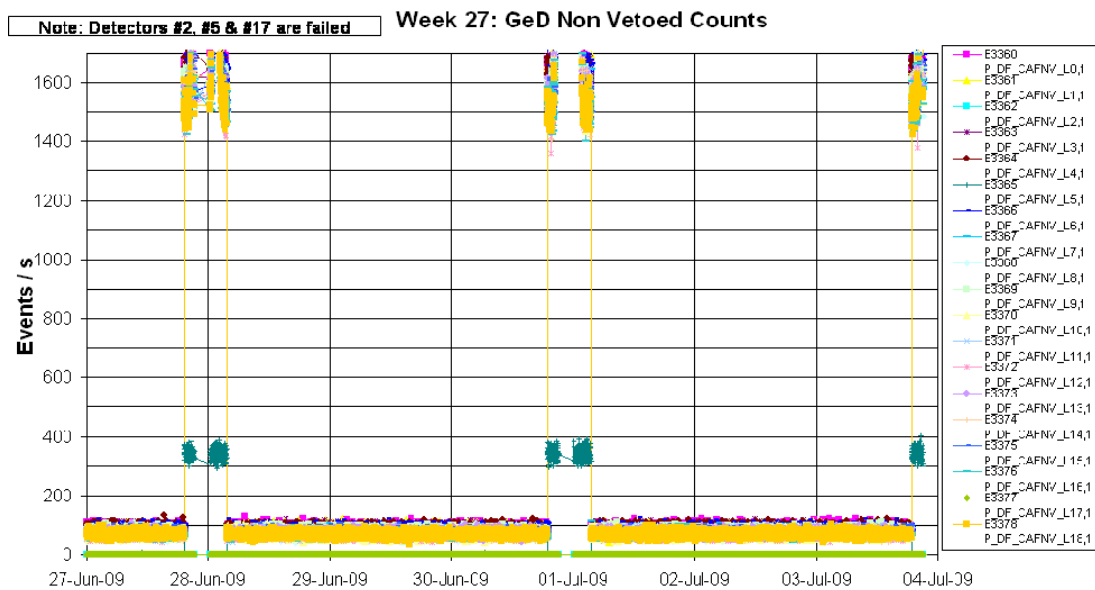
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting 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.

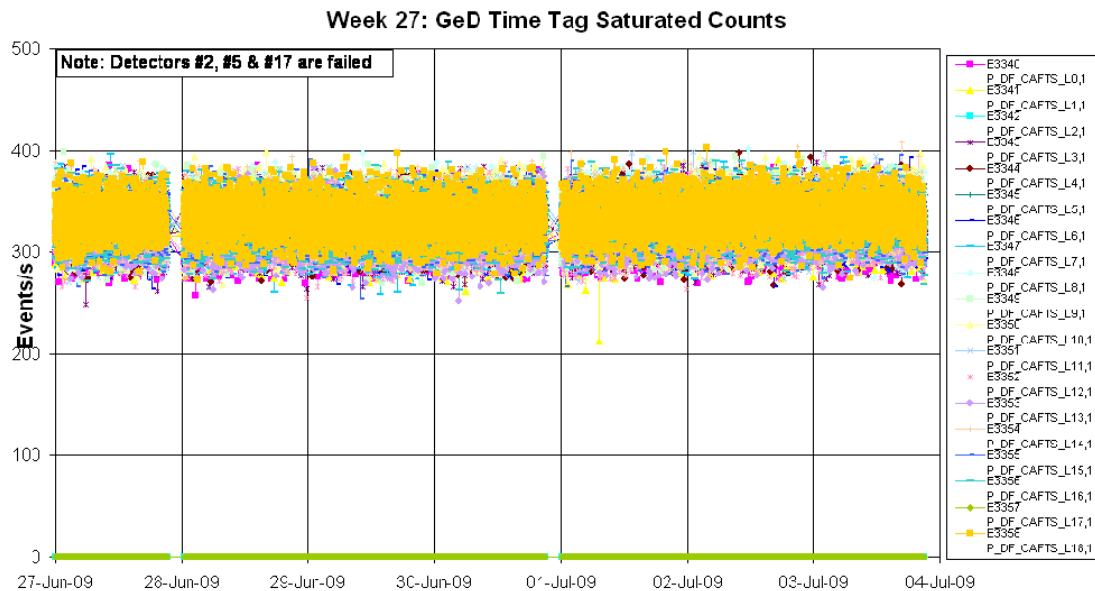
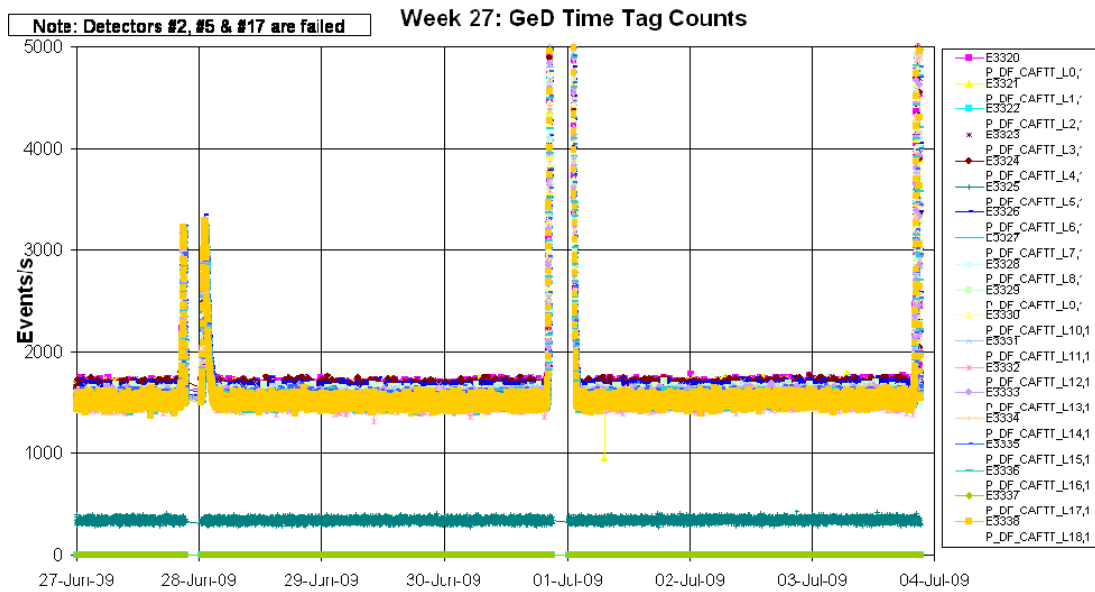
⁶ Data sampled every 8th packet (64sec)



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 period⁷.

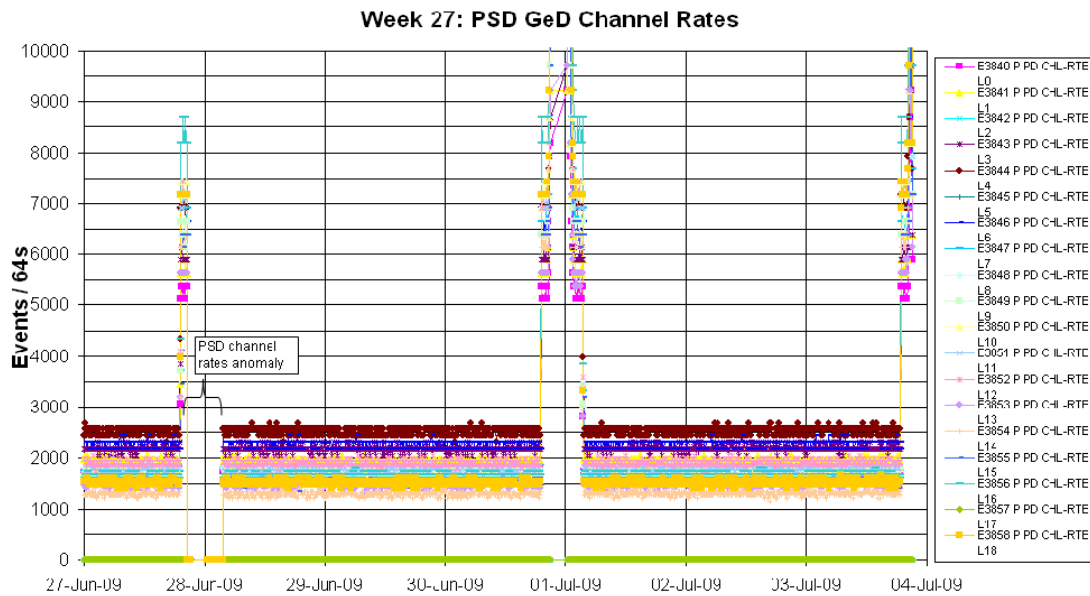


⁷ Data sampled every 8th packet (64sec)



PSD: The overall health of the unit is nominal. A PSD channel rates malfunction occurred on 2009-06-27, as reported in the Event Log below. The following plot shows the PSD channel rates over the reporting period⁸:

⁸ Data sampled every 8th packet (64sec)



Event Log:

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

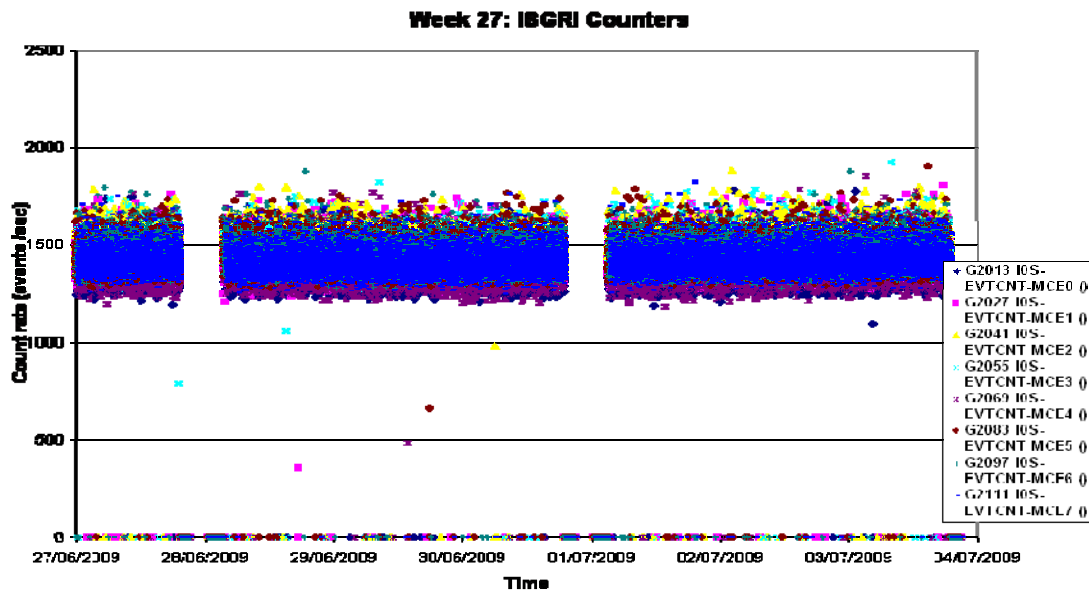
- On 2009-06-27 at 17:00:11Z TM parameter E2388 S AS AN-5V L38 went OOL (value = PARAM > SPEC). This is the FEE analogue status -5 V #38. TC sequence ES1831 was then sent to report the ACS HK parameters at 17:07:44Z, after which this parameter returned within limits.
- On 2009-06-27 at 20:38:46Z TM parameters E3840-E3858 (except E3842; E3845 and E3857) went OOL with value = 0. These are the PSD channel rates for all detectors (except the failed GeD #2; #5 and #17). This was about 1.5 hours after radiation belt entry of revolution 818, just before LOS at the end of the revolution. At AOS of revolution 819, on 2009-06-28 at 00:24:54Z, these parameters were still OOL with value = 0. They remained at zero until 2009-06-28 at 03:44:22Z, ~40seconds after the transition back to PHOTON mode following the reconfiguration at radiation belt exit of revolution 819. Anomaly Report INT_SC-194 (PSD Channel Rates Malfunction) has been updated to include this occurrence.
- On 2009-06-28 at 23:24:11Z TM parameter E2197 S AS DG5V L47 went OOL (value = PARAM > SPEC). This is the ACS FEE digital status 5 V #47. To report the ACS HK parameters, TCs E0282-E0287 of sequence ES1831 were sent twice starting at 23:36:10Z, after which this parameter returned within limits.

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:

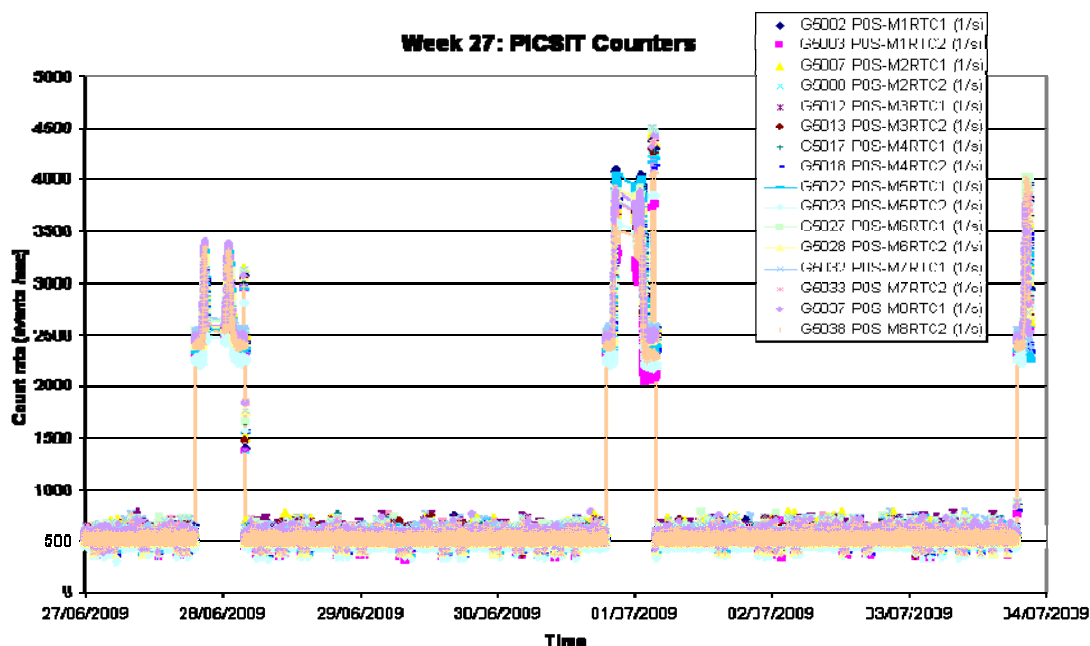


PICsIT

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

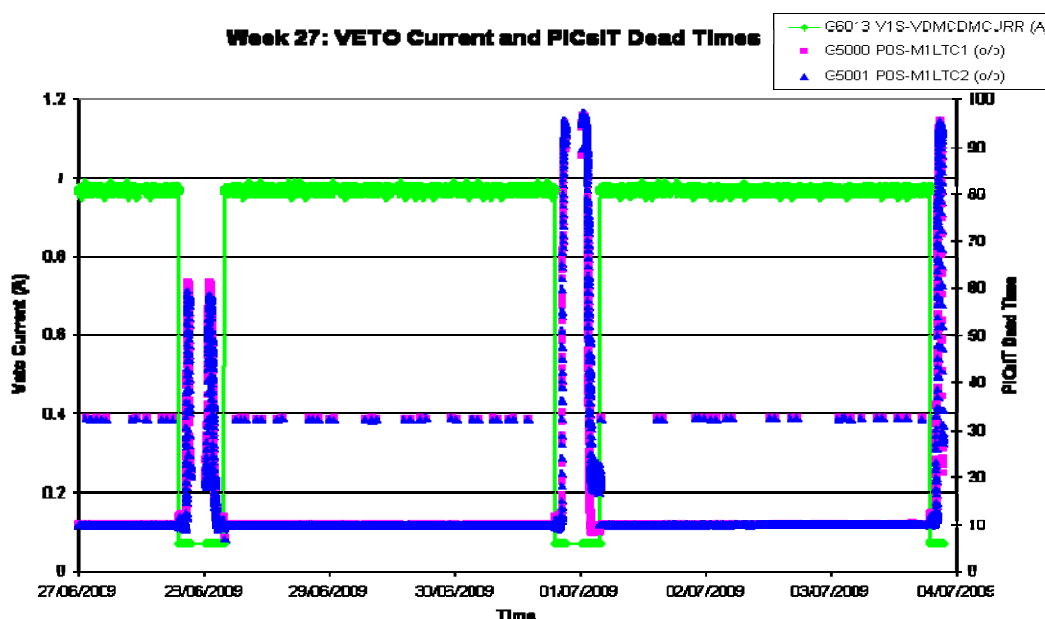
⁹ Data sampled every 4th packet (32sec)

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.

TM parameter G6061 went OOL Warning Low several times during the week. This is the VETO calibration counter. As in each case it shortly returned within limits of its

¹¹ Data sampled every 4th packet (32sec)

own accord, no action was taken. These frequent OOLs are due to a reduction in calibration counts as a result of the natural decay of the radioactive calibration source. The lower limit for this parameter will therefore be updated in the next database release.

2009-06-27 (DOY 178, Rev 818-819) to 2009-07-02 (DOY 183, Rev 820)

IBIS operations executed nominally.

2009-07-03 (DOY 184, Rev 820-821)

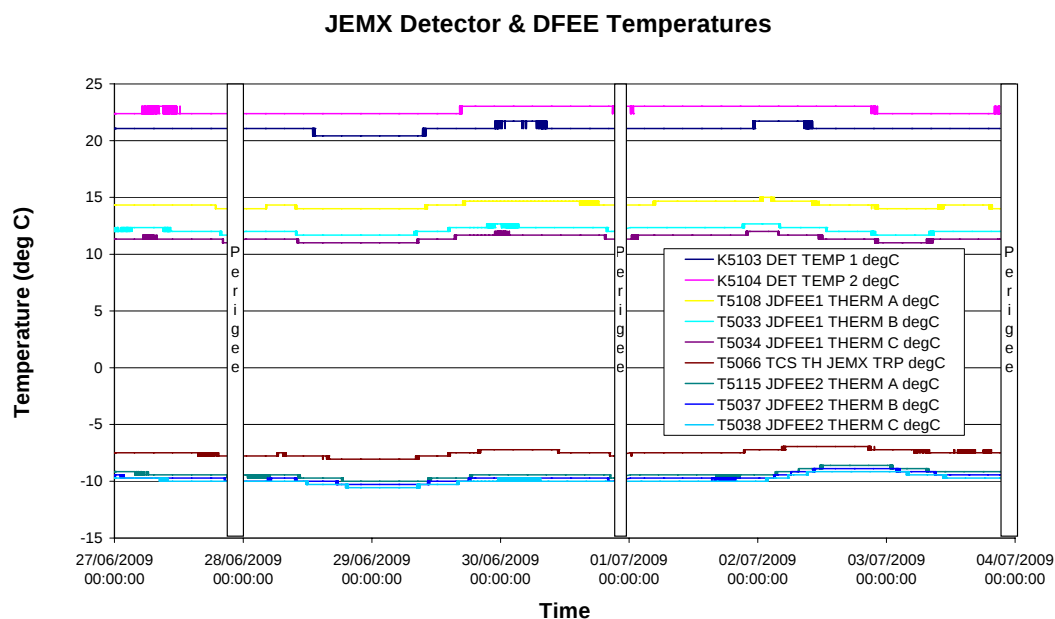
At 10:34Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. As the parameter remained OOL following the next slew, the following recovery procedure was then executed to force the histogram accumulation and download process to resume:

- 12:37:50Z FCP_IBIS1_0312
 - 12:43:59Z TC G0129 uplinked to return IBIS to Science Standard mode.
- IBIS operations continued nominally.

8.2.4 JEM-X Operations

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 graph¹².



JEM-X Daily Report

2009-06-27 (DoY 178 Rev 818) to 2009-07-03 (DoY 184 Rev 820)

JEM-X 1 operations executed nominally.

8.2.5 OMC Operations

2009-06-26 (DoY 177, Rev 818) to 2009-07-03 (DoY 184, Rev 820)

Nothing to report.

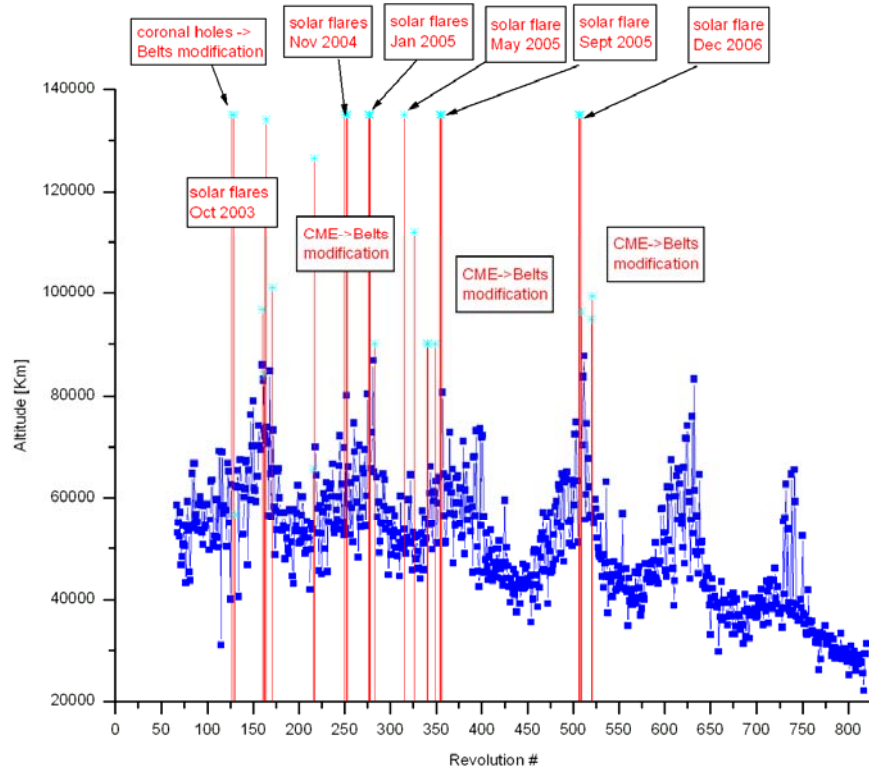
On DoY 178 at 19:11:27, DoY 181 at 18:59:51 and DoY 184 at 18:50:08 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

¹² Data sampled (1 frame in 8)

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]
818	RAD_ENTR R 2009-06-27T19:11:20Z	27/06/2009 20:31:18	29361.3	27-Jun-2009 20:18:50	31188.69
819	RAD_EXIT R 2009-06-28T03:42:30Z	28/06/2009 02:34:30	>>32753.2	28-Jun-2009 02:38:50	47638.66
819	RAD_ENTR R 2009-06-30T18:59:48Z	30/06/2009 20:14:22	29362.2	30-Jun-2009 20:14:31	29913.24
820	RAD_EXIT R 2009-07-01T03:30:20Z	01/07/2009 02:04:06	>>32783.1	01-Jul-2009 02:24:31	47255.91
820	RAD_ENTR R 2009-07-03T18:50:06Z	03/07/2009 19:58:14	31329.1	03-Jul-2009 20:04:31	30411.08

Reference

High radiation

Very small error vs reference (less than 10 minutes)

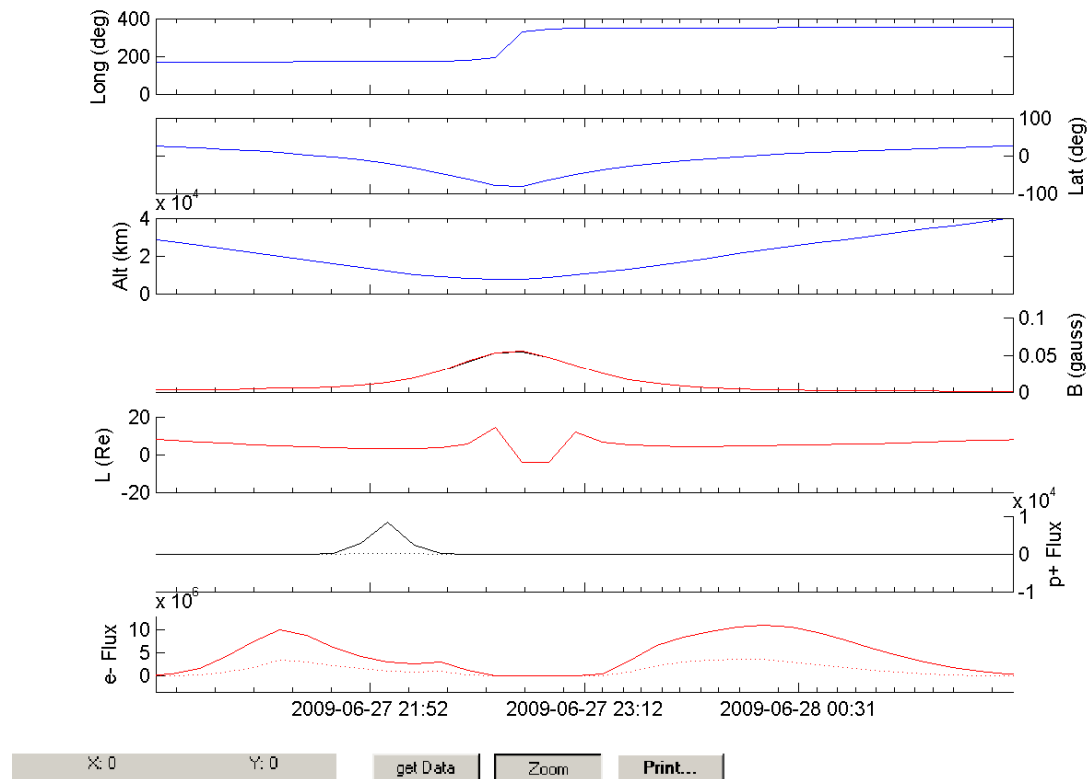
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

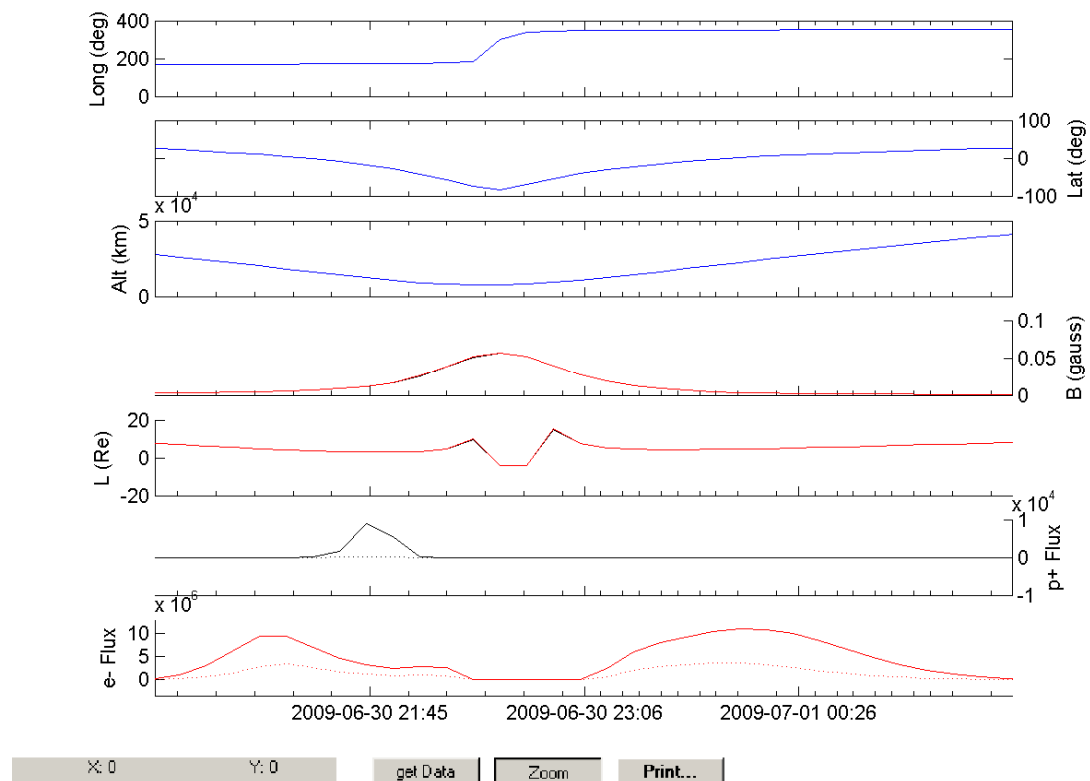
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM Predicted Radiation Belt Passages

Rev 818



Rev 819



Rev 820

