

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 349
Week 22
01.06.09
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 23.05.09 until 29.05.09 (both dates inclusive) and covers the revolutions 807, 808 and 809.

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 3C 454.3 (RA 22:53:57.74, DEC +16:08:53.5), a SAS Calibration at attitude (RA 22:54:00.00, DEC +16:30:00.0) and a raster dither of NGC 4151 (RA 12:10:32.00, DEC +39:24:19.0).

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 were missed from TL, during the observation period.

The fuel consumption over the period between 23/05/2009 and 29/05/2009 was 0.0693 Kg. The remaining propellant is in the order of 134.1360 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

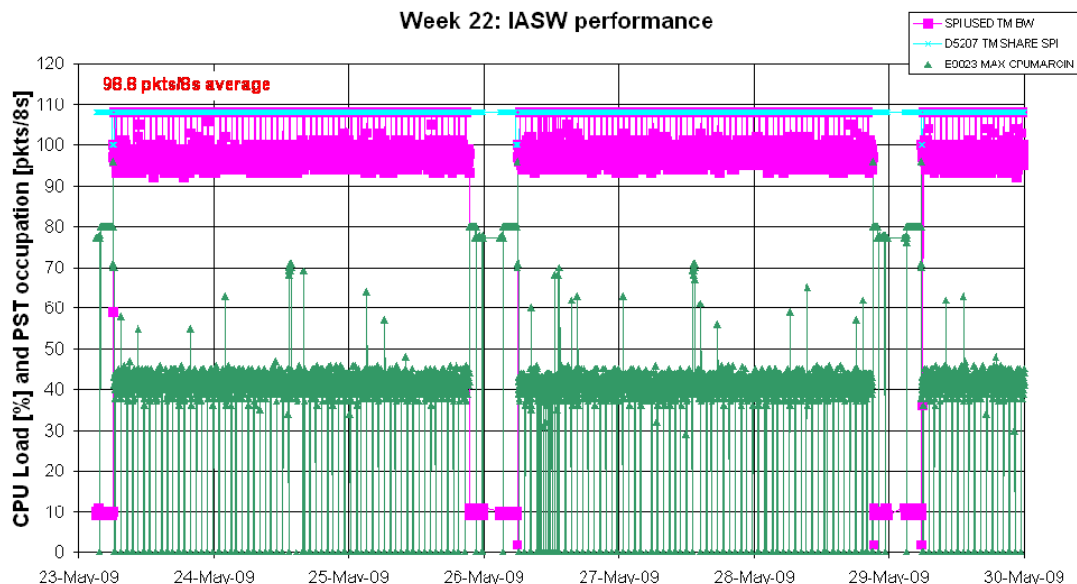
3.2.1 SPI

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).

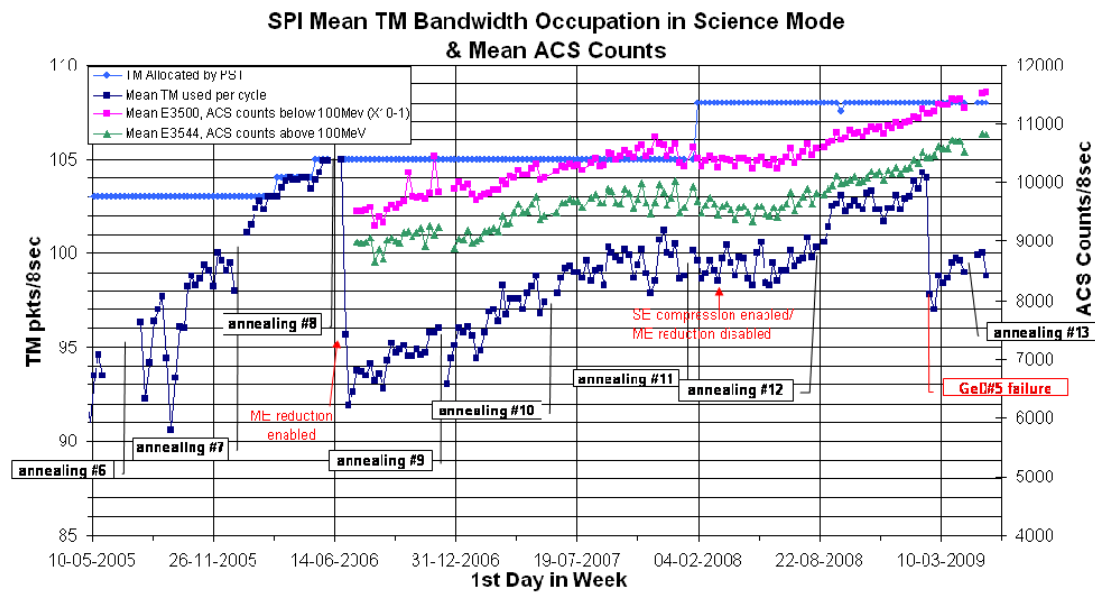
The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K $\pm$ 1K.

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 108 packets/cycle and the average telemetry occupation was 98.8 packets/cycle.

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



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.



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

3.2.2 IBIS

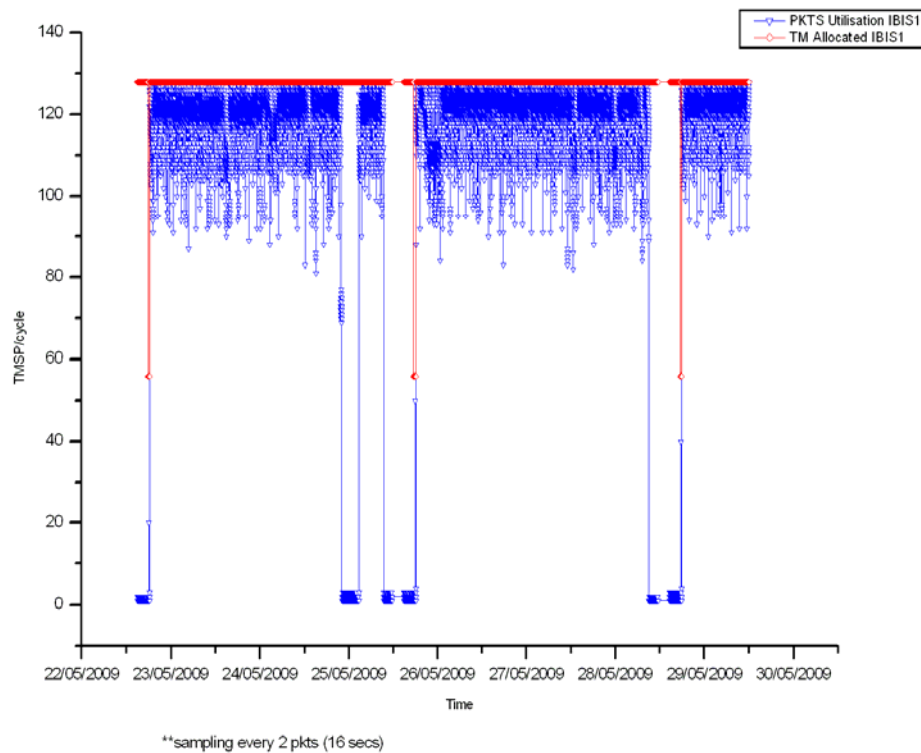
The overall status of IBIS is nominal.

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

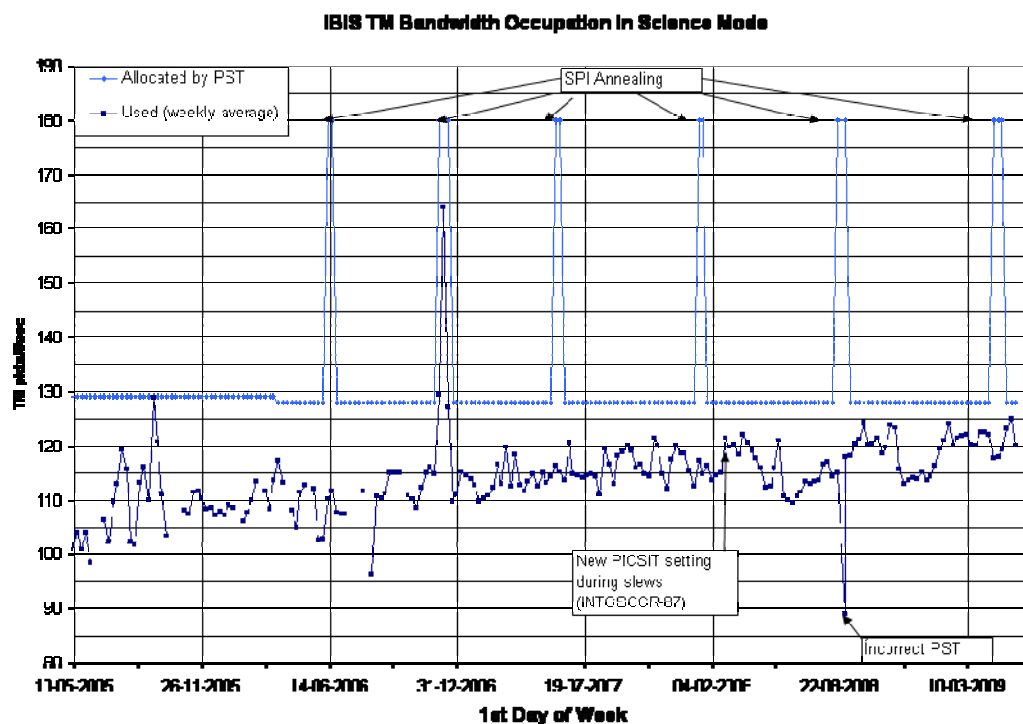
- PST allocation to IBIS above radiation belts: 128 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 120.02 packets/cycle (down 4.96 on previous week)
- Percentage of TM cycles for which bandwidth usage was 128 packets/cycle: 4.36%

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

IBIS - TM Bandwidth Utilisation Rev 806-809



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.

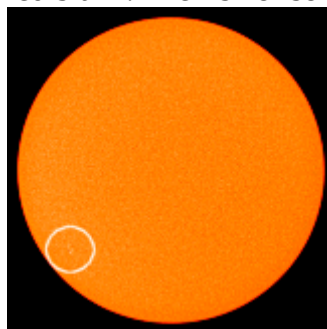
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

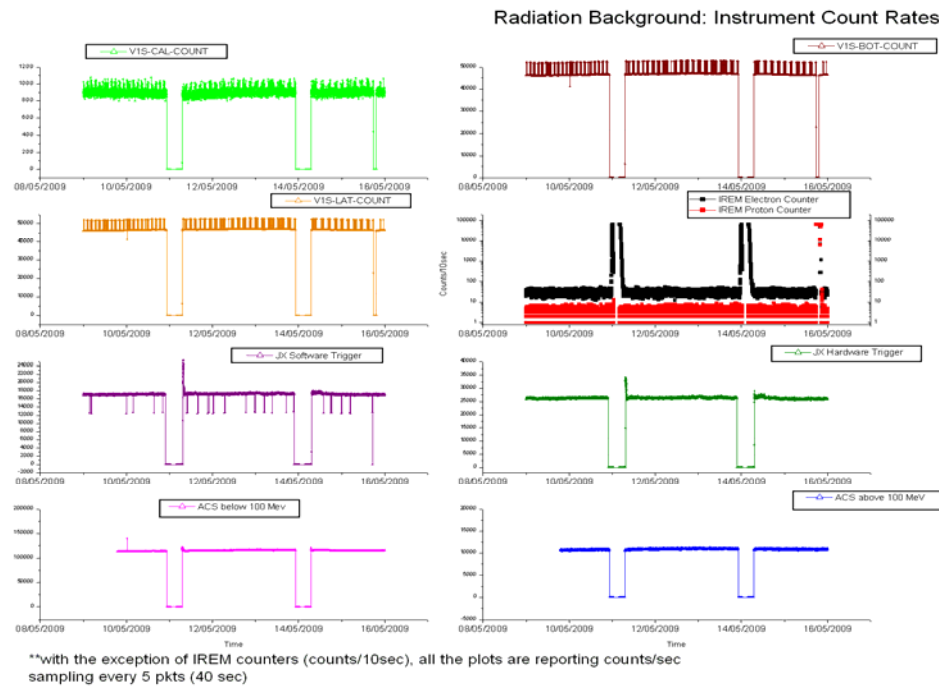
The observation period was characterised by low solar activity. A small sun-spot was emerging at the start of the week, but had disappeared by the following day, for the rest of the week, the sun remained blank. The risk of solar flares was very low.



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

3.2.6 Radiation Background

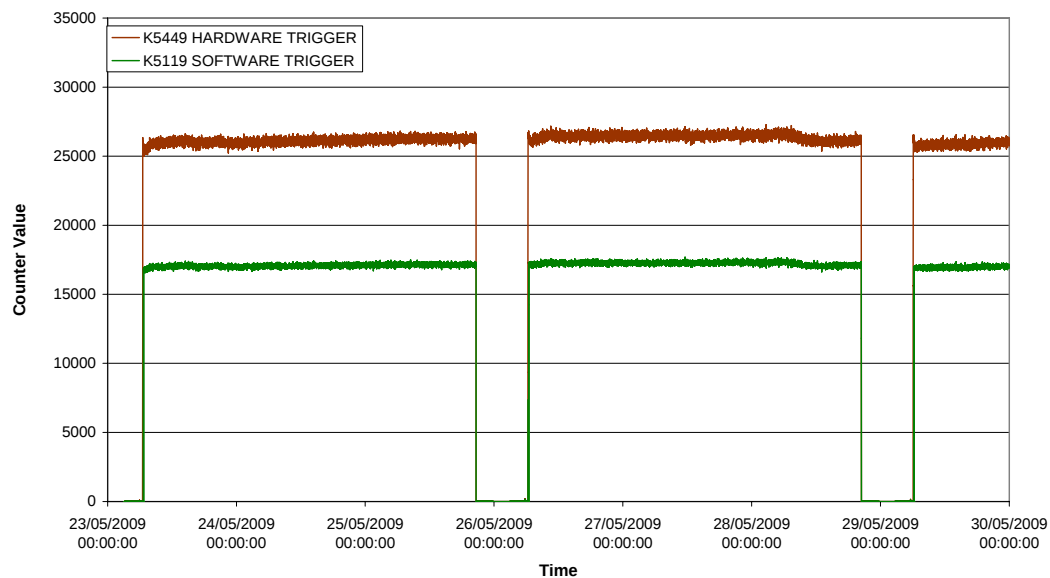
The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week:



JEM-X Count Rates

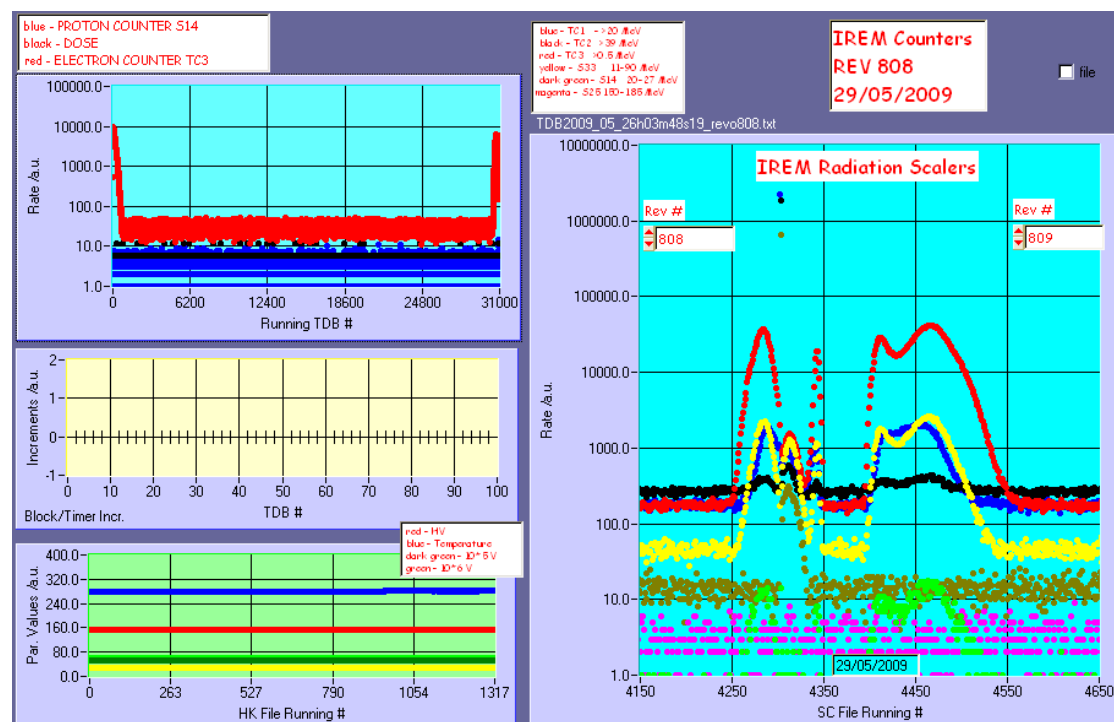
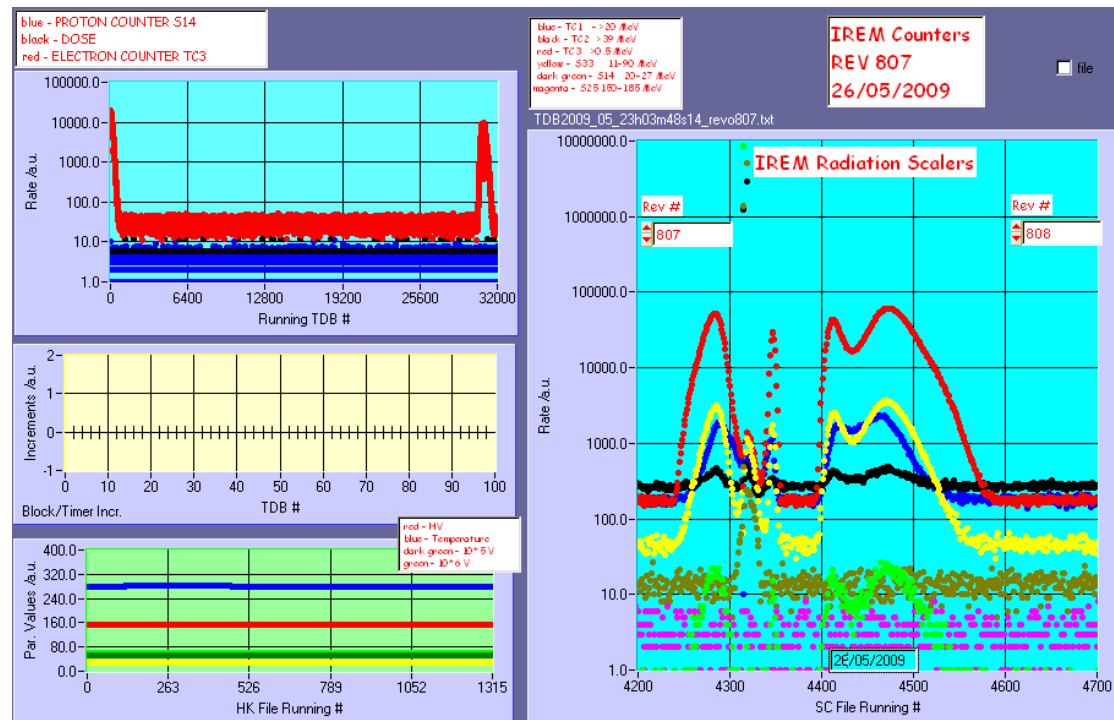
JEM-X count rates over the reporting period are displayed in the following graph¹.

JEMX-1 Count Rates



¹ 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:



4 Ground Facilities

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

4.1 Mission Operations Centre

The performance of the MOC was very good this week, there were 5 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 excellent this week, there were no reports of bad TM from any ground station.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 812 to 817.

New observations have been planned for revolutions 810 to 813, but revolutions 809, 810 and 811 had to re-planned, sometimes more than once, due to a pointing position devoid of sufficient bright stars for the start-tracker in the BGC 4151 field.

New TSFs have been received for revolutions 808 to 810.

2. Observation status

No new ECS files has been received the last received is for revolution 797 with 795 and 796 still missing.

3. ISOC Science Data Archive

A meeting between ISOC and ISDC took place 26+27 May at ISDC.
There are still unresolved problems with the group settings in the incoming data that hold up ingestion at ESAC.

4. ISOC system

V22 is in use with no problems reported.

5. Problems

No new problems.

5 Special Events

6 Anomalies

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

AR id	Date Created	Subject	Segment	Status
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Doc. Title : INTEGRAL Mission Report #349
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI
Date : 01/06/09

Issue : 1
Rev. : 0
Page : 11

AR id	Date Created	Subject	Segment	Status
INT_SC-257	2009-06-02	IBIS MCEs 5-8 OFF due to SEU on PLM PDU-A BOARD 5A HLCL2	Payload	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, 23/05/2009 – 29/05/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 64 Open Loop Slews, 82 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

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

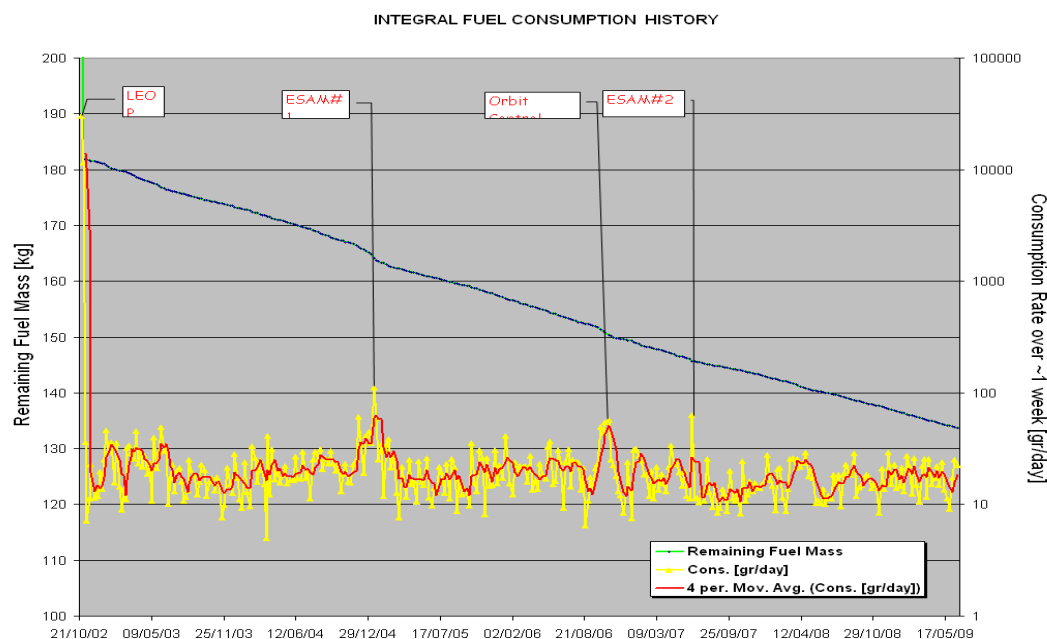
The OTF was not reached during part of PID 08080004.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 29/05/2009 is reported in the plot below.

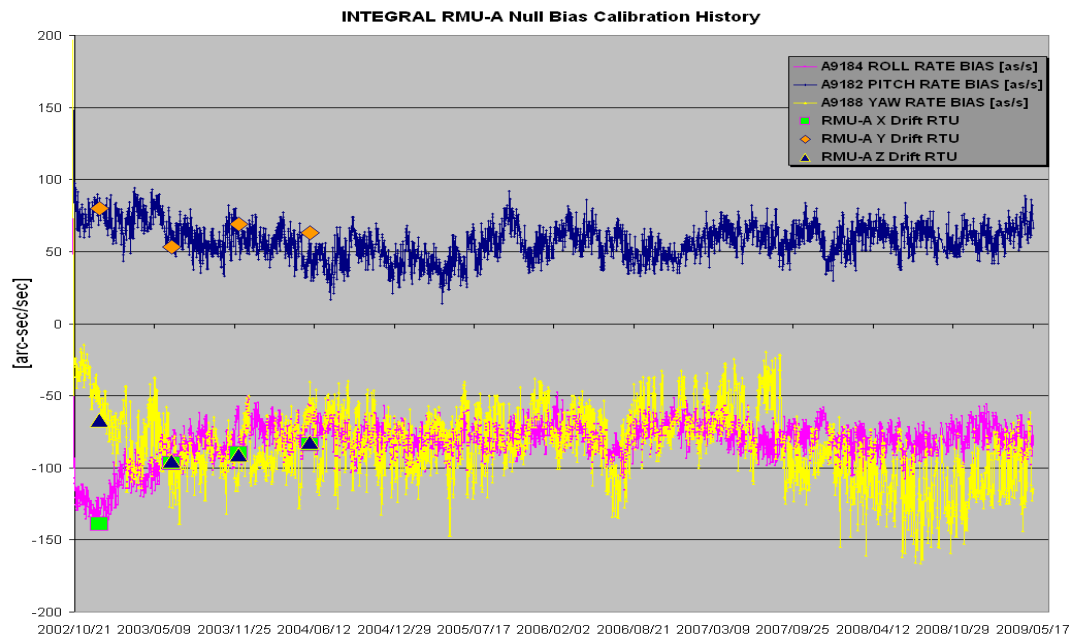


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

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 29/05/2009 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.



23/05/2009 (Day of Year 143, Revolution 806-807)

Nothing to report.

24/05/2009 (Day of Year 144, Revolution 807)

Nothing to report.

25/05/2009 (Day of Year 145, Revolution 807)

Nothing to report.

26/05/2009 (Day of Year 146, Revolution 807-808)

Loss of guide star: at 07:25:54z a loss of the selected guide star occurred during PID 08080003. The origin of the event is likely due to false event affecting the STR.

As foreseen by the IPS logic, the ACC did switch ON the IMU 1, a new automatic mapping was commanded and a new guide star picked. The next slew 08080004 was manually updated in TL.

The OTF was not reached during part of PID 08080004.

27/05/2009 (Day of Year 147, Revolution 808)

Nothing to report.

28/05/2009 (Day of Year 148, Revolution 808)

Nothing to report.

29/05/2009 (Day of Year 149, Revolution 808-809)

FDS failed TPF update: at 15:40z the FDS did not perform the update of the slew ID 08090012. FD Team reported that the job scheduler stopped. A manual recovery was performed and the slew updated in TL. The Job scheduler was manually re-started.

No impact on TL.

8.2.2 SPI Operations

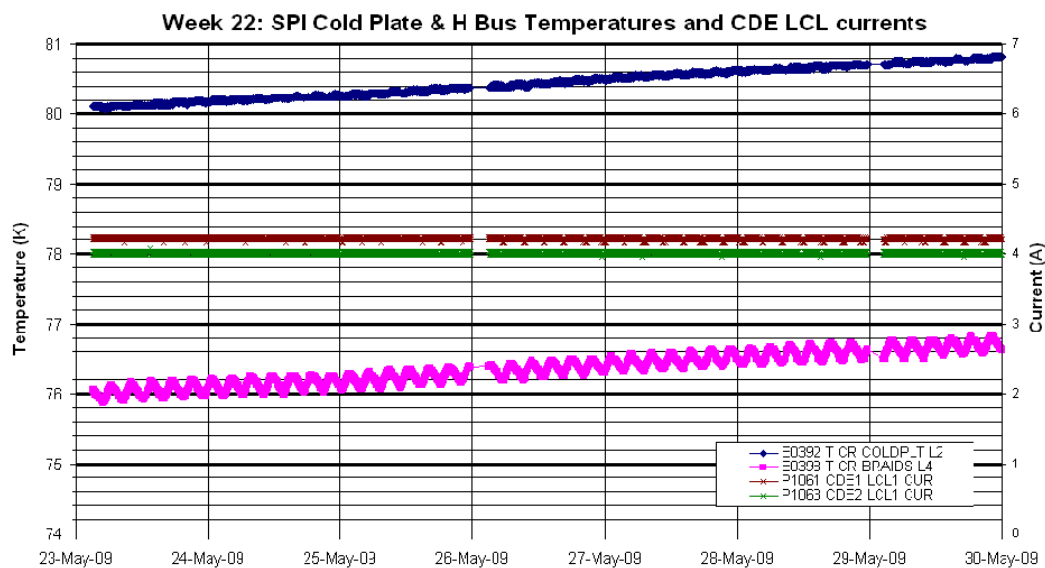
Unit Temperatures: All the equipment temperatures are inside the operational limits.

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 37 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.21A
- CDE2 LCL Current = 4.02A

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:

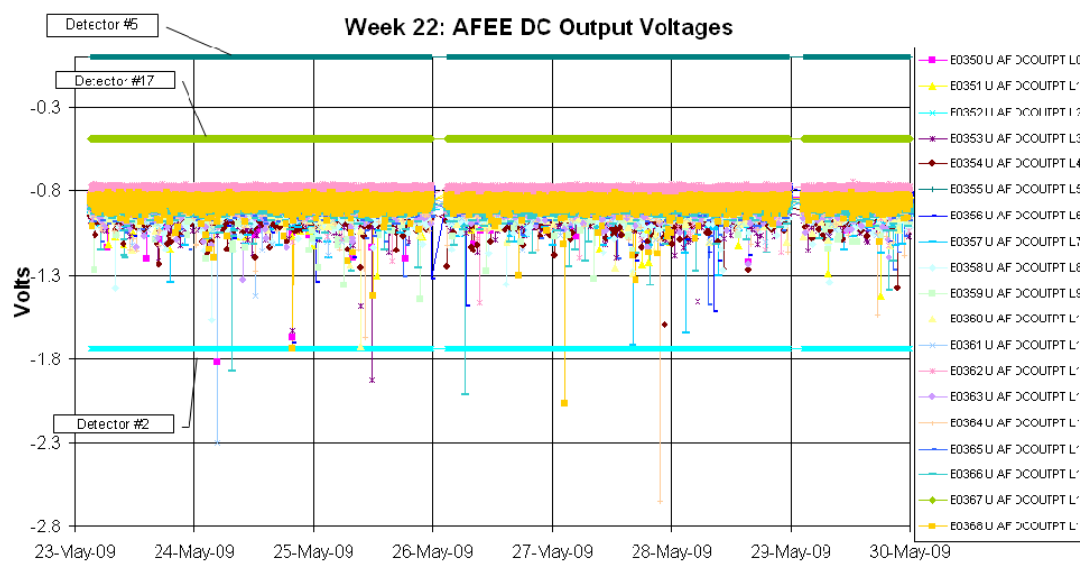


DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling

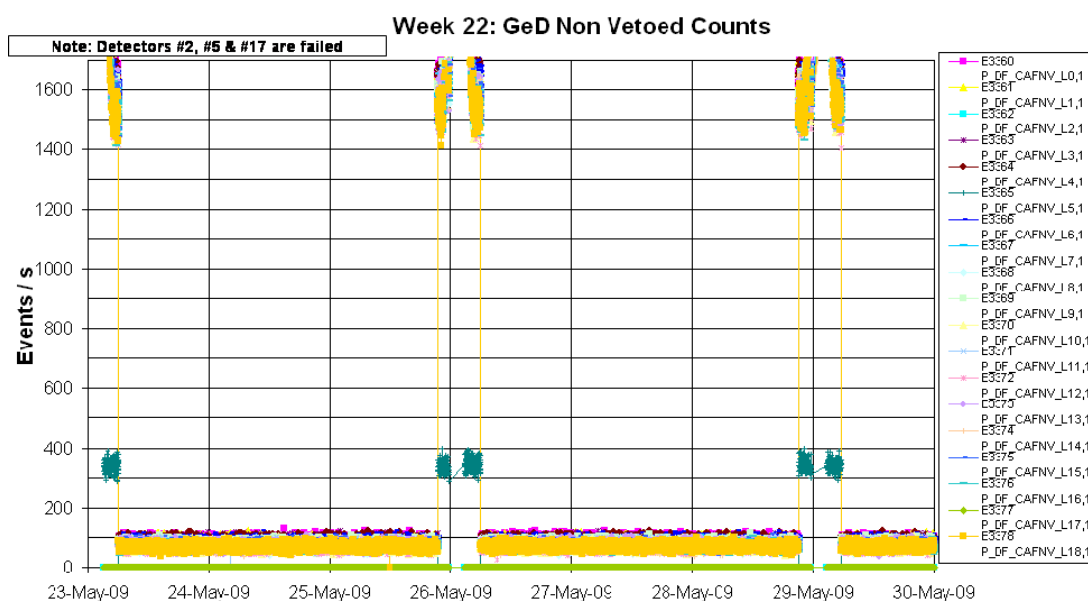
factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

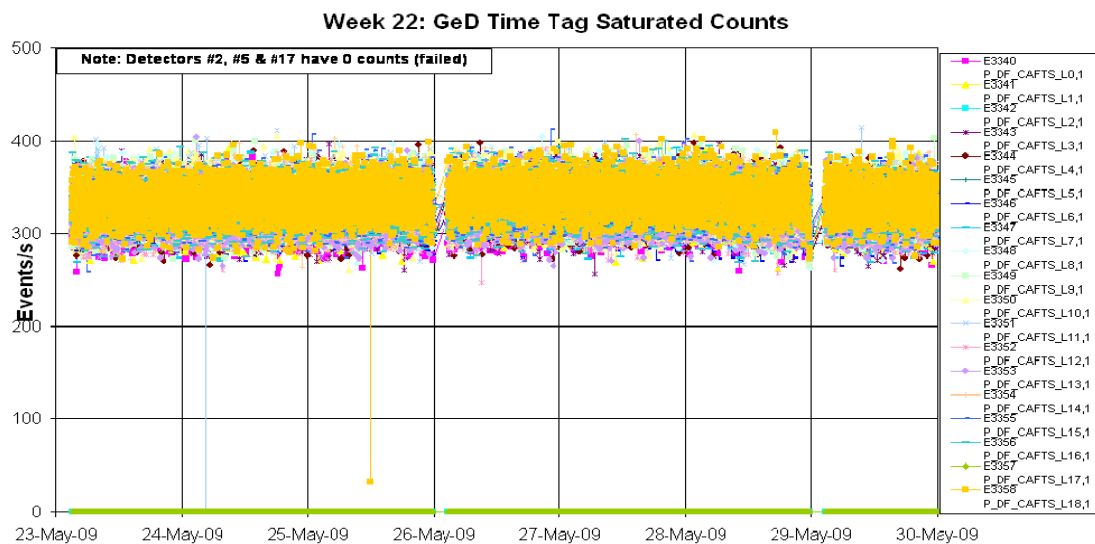
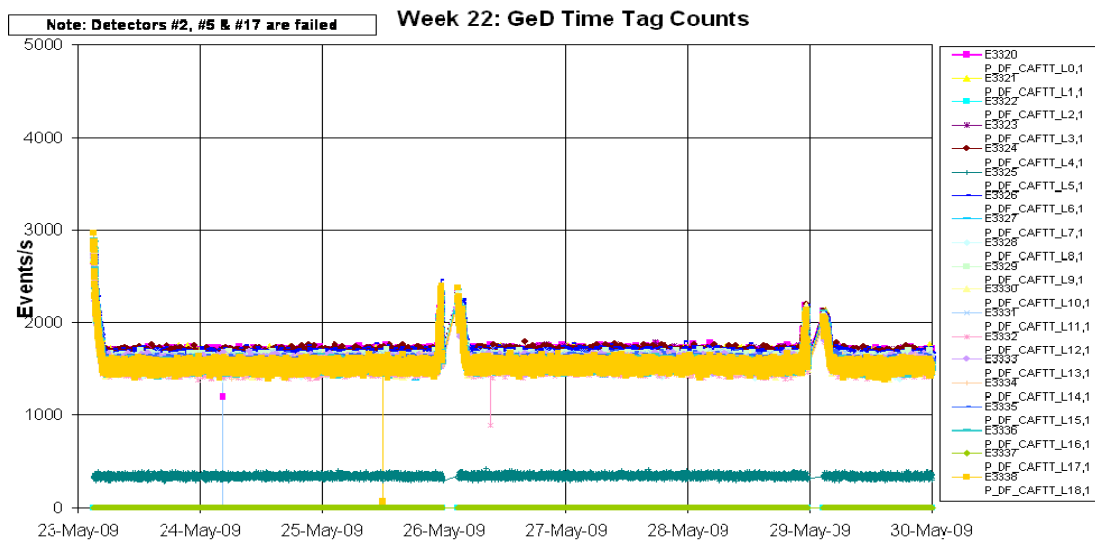
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

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

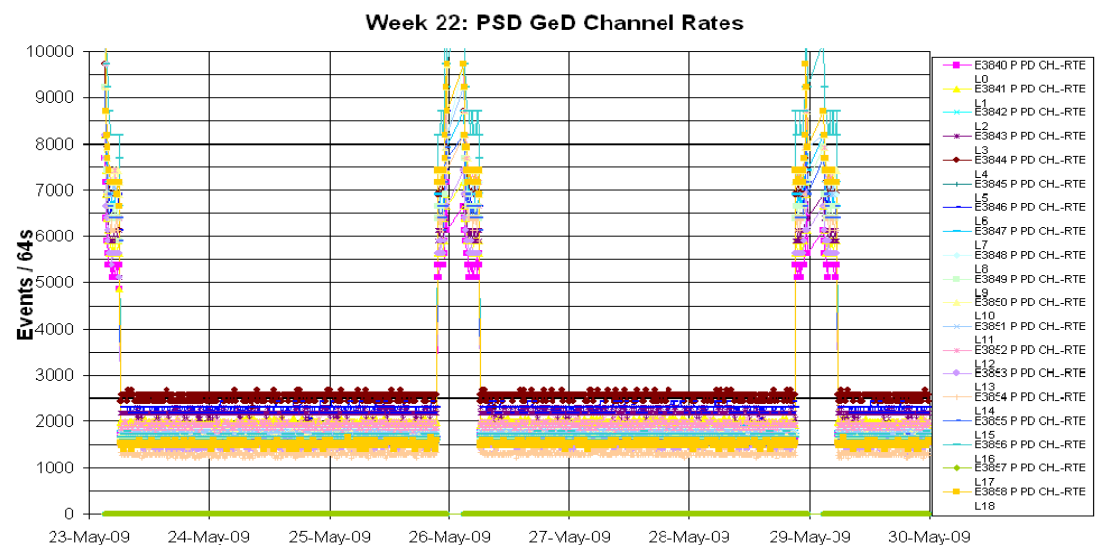


DFEE: The health of the unit is nominal. The following plots show the Non Vetoeed, Time Tag and Time Tag Saturated Event count rates during the reporting period.





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



Event Log:

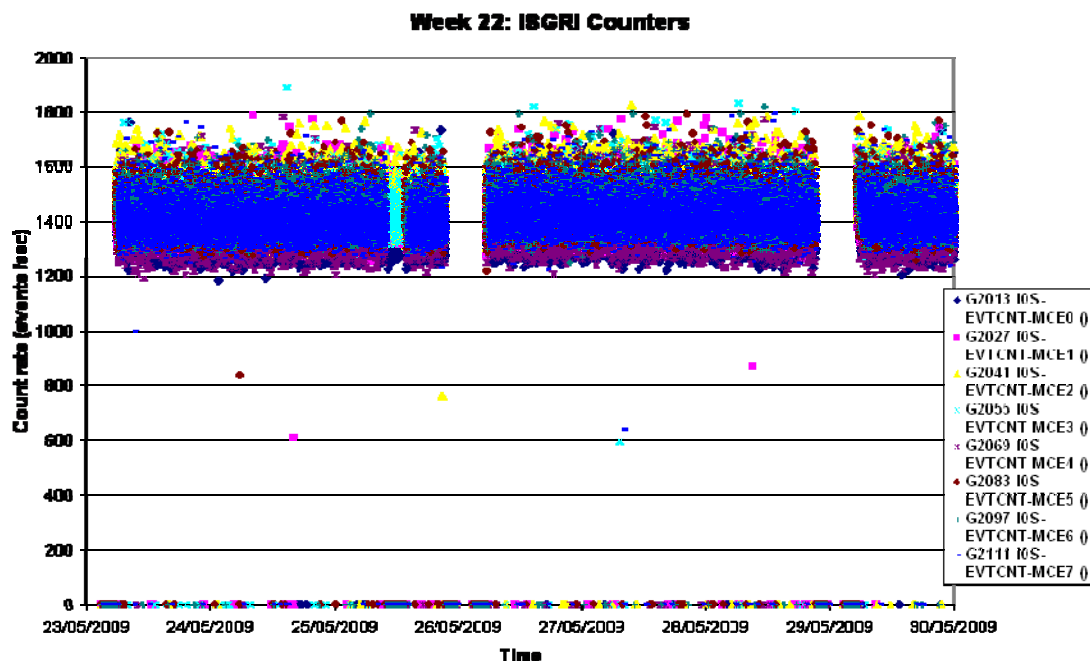
- No non-nominal events occurred with SPI over the reporting period.

8.2.3 IBIS Operations

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

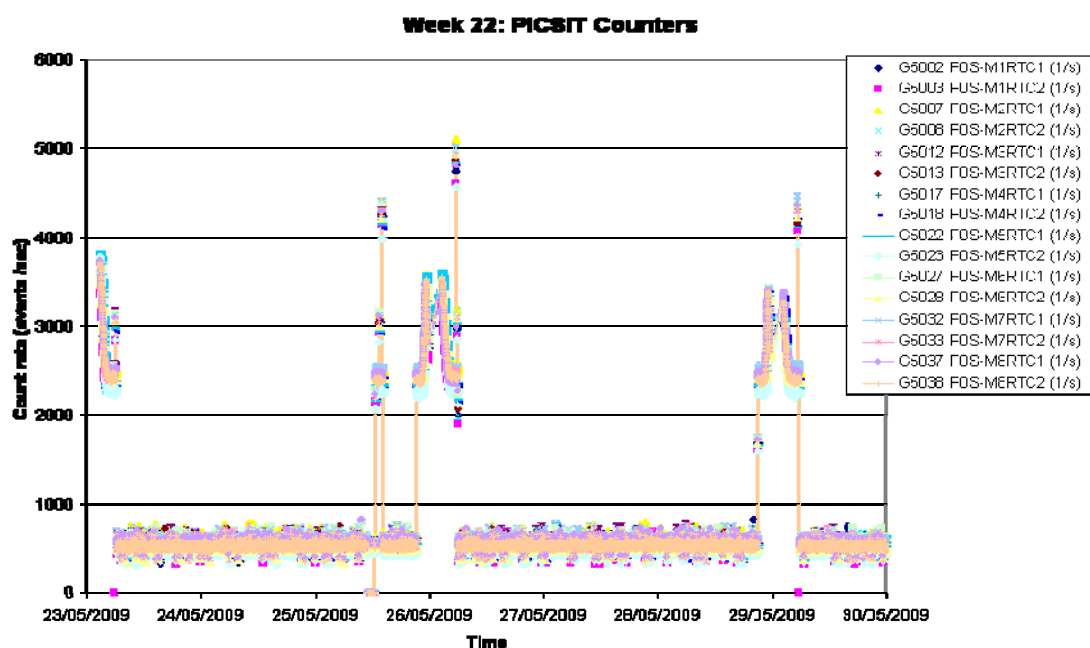
ISGRI

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



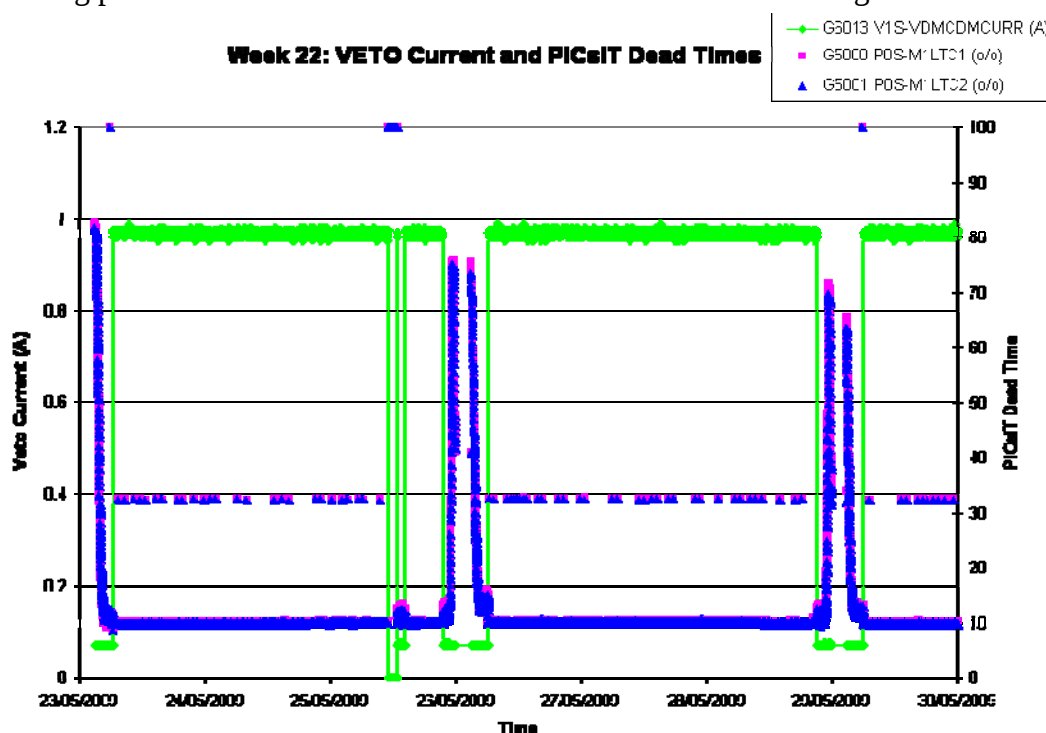
PICsIT

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



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:



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.

2009-05-23 (DOY 143, Rev 806-807) to 2009-05-24 (DOY 144, Rev 807)

IBIS operations executed nominally.

2009-05-25 (DOY 145, Rev 807)

At 09:53:16Z TM parameter P2124 P HLCL 5A2 STA (28 BOARD 5-A LCL 2 Status) failed Status Consistency Check, with value = OPEN. Also, starting at 09:53:03Z OEM APID 1280 ID 129 ANOMALY IBIS1 IASW TIME-OUT TRANSMITTING LSL DATA began to be received at a rate of 4 OEMs every 8 second TM cycle.

The following TSW are powered by this LCL:

- P2206 TSW STA MCE5 A (status CLOSE)
- P2207 TSW STA MCE6 A (status CLOSE)
- P2208 TSW STA MCE7 A (status CLOSE)
- P2209 TSW STA MCE8 A (status CLOSE)
- P2220 P TSW5 5A2 SPARE (status OPEN)
- T8000 TSW STA CSI HTRA (status OPEN)

Therefore the effect of this SEU was to cut off power to the ISGRI MCEs 5, 6, 7 and 8 [1-8 scheme]. This was therefore also the cause of the OEMs reported above.

Following the reaction specified for an SEU on P2124 in the cross-reference, procedure FCP_EPS_1523 PLM PDU-A BOARD 5A HLCL2 ON/OFF was executed to switch the P HLCL 5A2 back ON. As part of this procedure the following was performed:

- As it was required to OPEN the IBIS MCEs TSW listed above, the IASW was commanded to Standby at 10:11:07Z via FCP_IBIS1_0313 IASW transition to Stand-By;
- 10:15:40Z FCP_IBIS1_0343 IBIS ISGRI MCE5 OFF (actually MCE6 in 1-8 scheme above);
- 10:18:23Z FCP_IBIS1_0341 to switch OFF MCE5 [1-8 scheme];
- 10:20:48Z FCP_IBIS1_0345 to switch OFF MCE7 [1-8 scheme];
- 10:22:02Z FCP_IBIS1_0347 to switch OFF MCE8 [1-8 scheme];
- 10:25:47Z TC P4097 P HLCL 5A2 ON (A) sent.

Following this, a recovery of IBIS to operations was performed as follows:

- 11:00:03Z – 11:28:24Z MCEs were switched back on again using procedures FCP_IBIS1_0087 to FCP_IBIS1_0099. Initially, an attempt was made to only activate the MCEs which had been switched off. However, the ECR configuration (which indicates the ON/OFF status of the subassemblies to the IASW) set in these procedures is fixed assuming a certain switch-on order. This, along with the fact that this switch-on order is stipulated in the procedures, caused some confusion as to the correct sequence of operations required to re-activate the MCEs. In addition, due to the fixed parameters for the ECR in these procedures, the ECR for some MCEs which were ON, as well as VETO and PICsIT which were also still ON, were set to OFF. Once this was observed, and to ensure a complete and correct switch-on, the sequence of MCE activation was recommenced as specified in the procedures, including those for MCEs which had not been switched off. Thus the sequence of activations performed was [1-8 scheme]: MCE6; MCE8; MCE4; MCE3; MCE5; MCE6; MCE2; MCE8; MCE4; MCE3; MCE7. Following this, all MCEs were ON and behaving nominally and the ECR for all MCEs was ON. Also OEM APID 1280 ID 129 ANOMALY IBIS1 IASW TIME-OUT TRANSMITTING LSL DATA was no longer being received. However, MCEs 1-4 were in Nominal mode with biases at -120V and MCEs 5-8 were in Standby with biases at 0V.
- 12:39:58Z TC G0822 sent to restore ECR for PICsIT and VETO to ON. Following this, between 12:40:07Z and 12:40:30Z several occurrences of OEM APID 1280 ID 169 EVENT HK OUT OF SYNC were received. However, they stopped of their own accord.
- 12:44:13Z CRP_IBIS1_0010 IBIS SAFE CONFIG (Fast) executed to ensure a safe configuration (IASW in Standby; VETO in Standby; all ISGRI MCEs in Standby with biases set to 0V).
- 13:37:11Z ED GEISCL03 re-uplinked to restore the ISGRI context tables to the MCEs and re-activate MCEs to Nominal mode with biases at -120V.
- 14:16:30Z FCP_IBIS1_0201 VETO Nominal Mode executed.

- 14:44:50Z ED GESTAN02 re-uplinked with the planned observation parameters to return IBIS to Science Standard mode.
 IBIS operations continued nominally.
 This is recorded as Anomaly Report INT_SC-257.

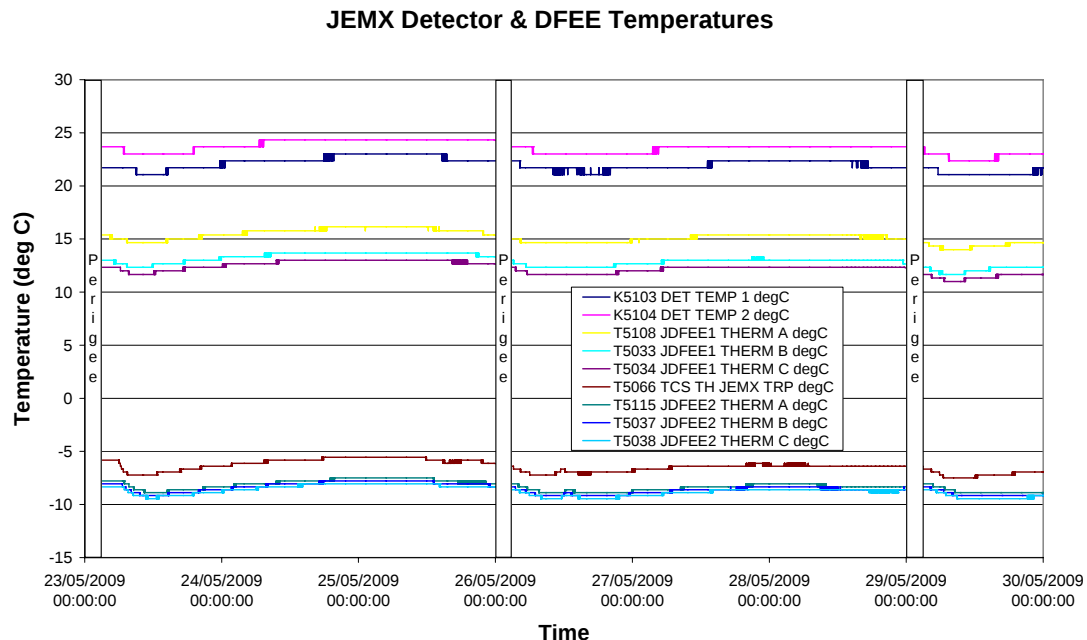
2009-05-26 (DOY 146, Rev 807-808) to 2009-05-29 (DOY 149, Rev 808-809)

IBIS operations executed 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 graph².



JEM-X Daily Report

2009-05-23 (DoY 143 Rev 807) to 2009-05-29 (DoY 149 Rev 809)

JEM-X 1 operations executed nominally.

8.2.5 OMC Operations

2009-05-23 (DoY 143, Rev 807) to 2009-05-29 (DoY 149, Rev 809)

Nothing to report.

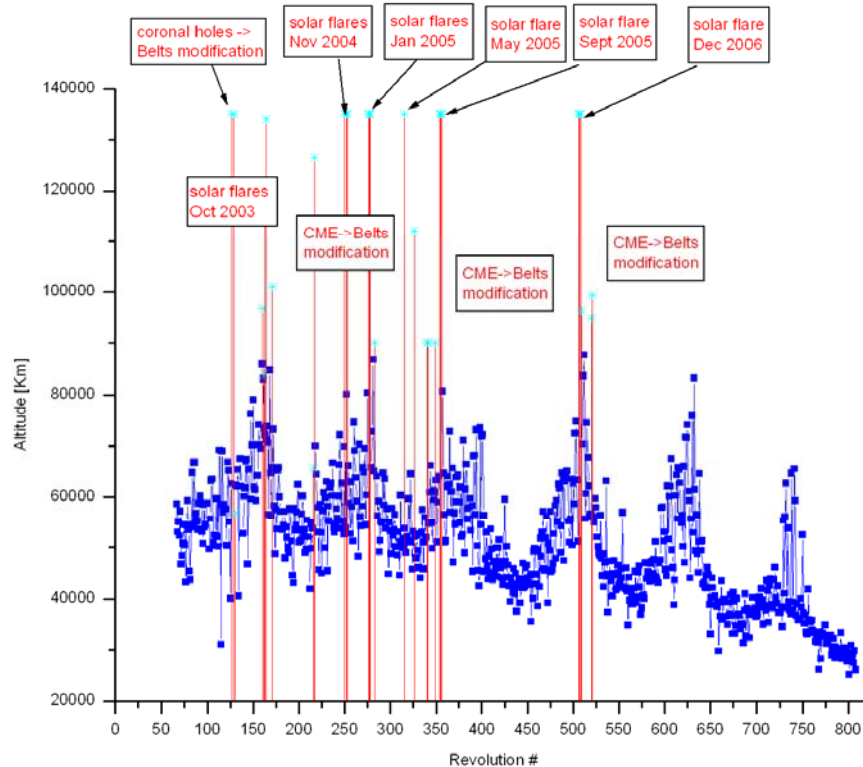
² Data sampled (1 frame in 8)

On DoY 145 at 21:24:37 and DoY 148 at 21:10:54 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]
807	RAD_EXIT R 2009-05-23T06:10:38Z	23/05/2009 04:31:56	>>36172.8	23-May-2009 04:59:37	47053.65
807	RAD_ENTR R 2009-05-25T21:24:31Z	25/05/2009 22:46:20	29835.0	25-May-2009 22:29:42	30999.88
808	RAD_EXIT R 2009-05-26T05:57:36Z	26/05/2009 04:25:32	>>36219.7	26-May-2009 04:49:42	47625.67
808	RAD_ENTR R 2009-05-28T21:10:49Z	28/05/2009 22:44:28	26126.8	28-May-2009 22:09:42	32081.23
809	RAD_EXIT R 2009-05-29T05:44:02Z	29/05/2009 03:50:21	>36210.1	29-May-2009 04:29:42	46694.34

Reference

High radiation

Very small error vs reference (less than 10 minutes)

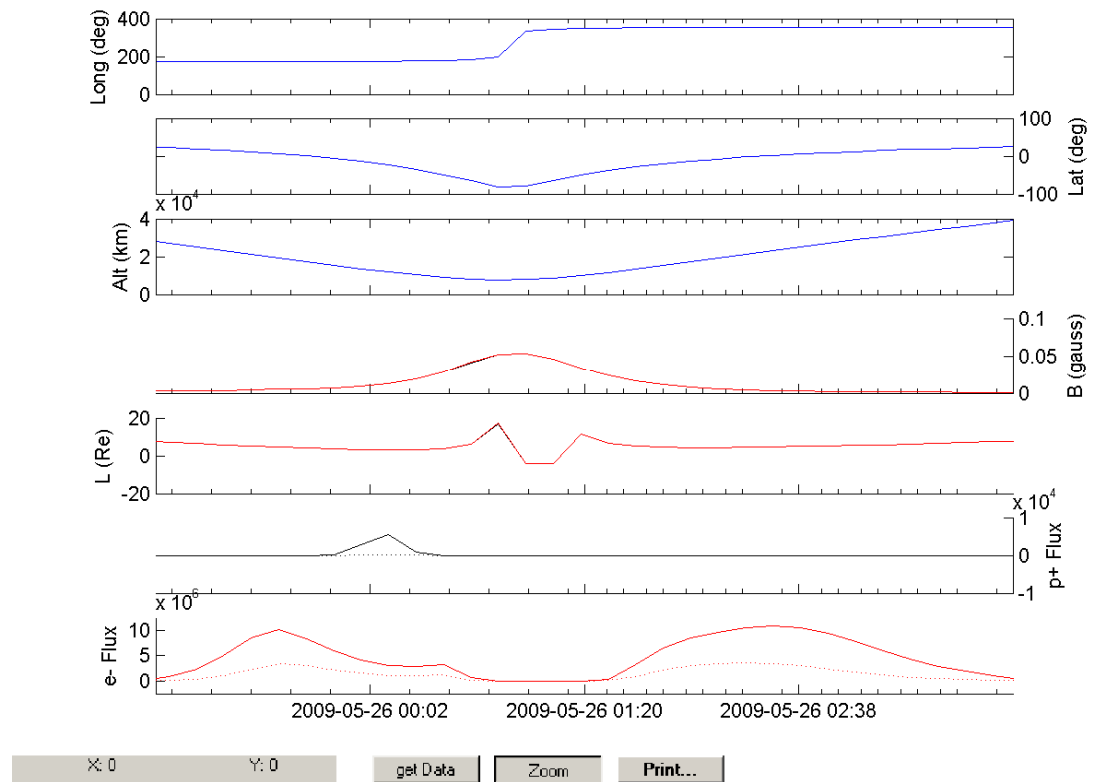
Small error vs reference (between 10 and 30 minutes)

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 807



Rev 808

