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

INTEGRAL
Mission Report

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

No. 352
Week 25

22.06.09

Routine Phase

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LIST OF CONTENTS

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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 13.06.09 until 19.06.09 (both dates inclusive) and covers the revolutions 814 and 815.

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) and a raster dither of the Virgo Cluster (RA 12:26:32.10, +12:43:24.0).

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 13/06/2009 and 19/06/2009 was 0.1696 Kg. The remaining propellant is in the order of 133.6894 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

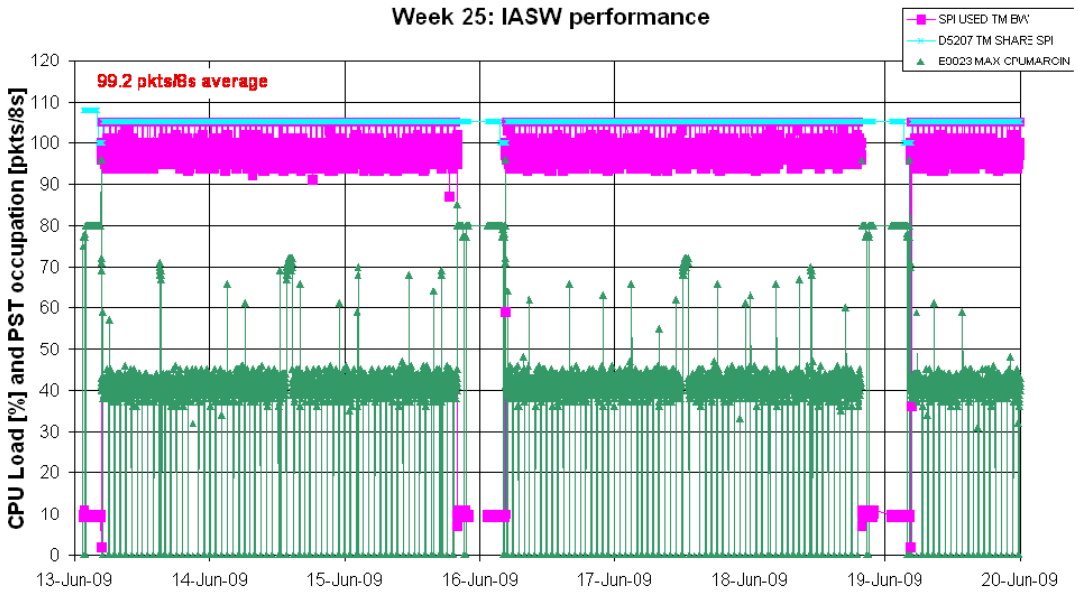
3.2.1 SPI

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).

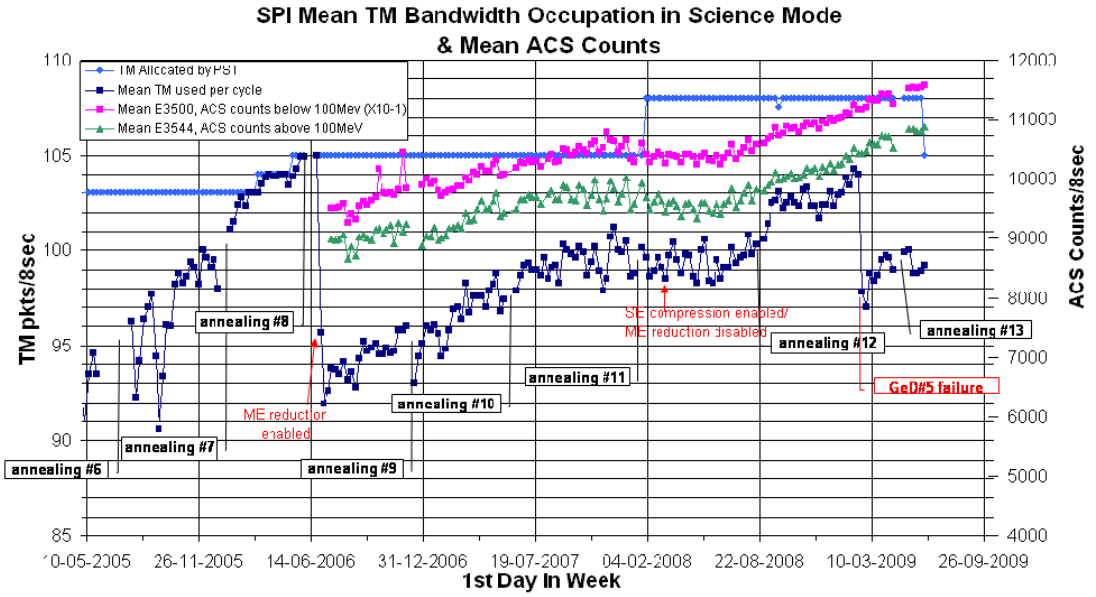
The Stirling compressors are working nominally. The Germanium detectors' temperature was kept in the range 80K+/-1K.

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 99.2 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.

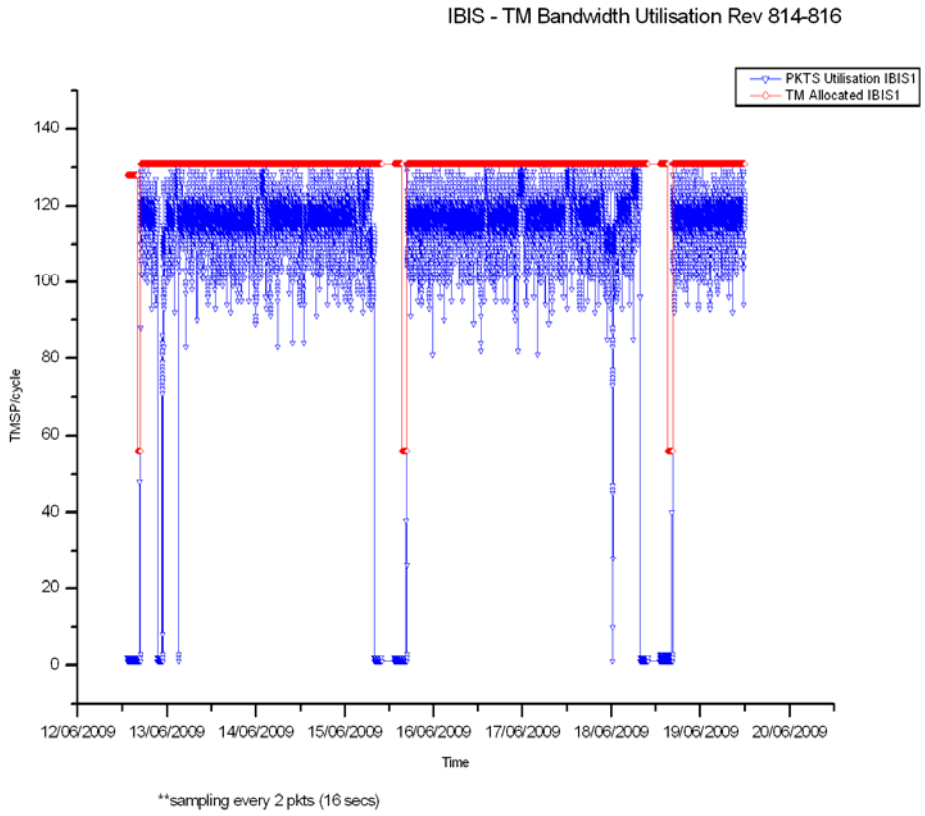
3.2.2 IBIS

The overall status of IBIS is nominal.

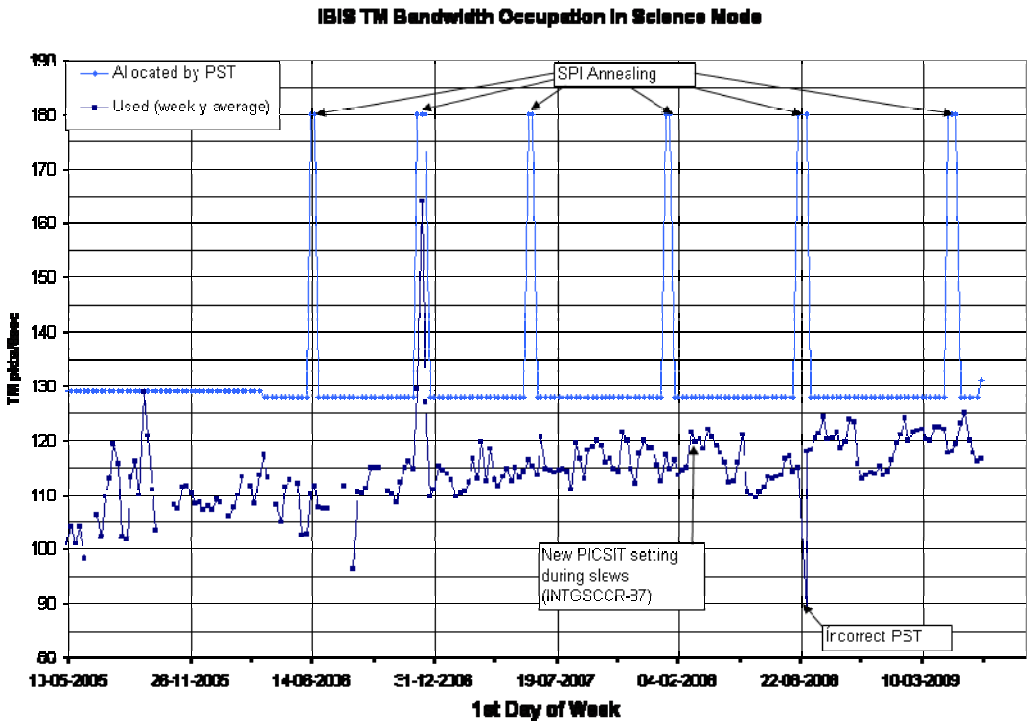
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 116.57 packets/cycle (up 0.47 on previous week)
- Percentage of TM cycles for which bandwidth usage was 131 packets/cycle: 0.60%

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.

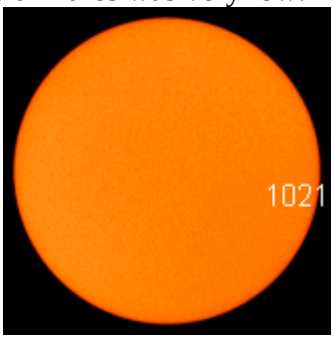
During this reporting period, 137 of the 139 planned science pointings were executed nominally, 1 was interrupted, and 1 lost.

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.

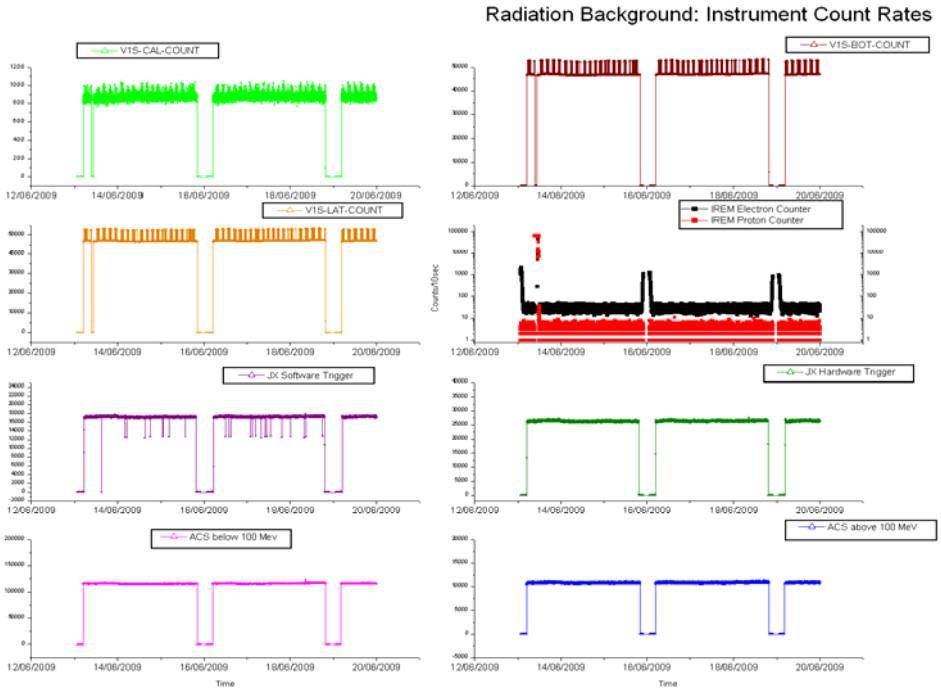
Solar Activity
The observation period was characterised by low solar activity. At the start of the week, the sun was blank. A small sun-spot emerged on the 17th June, to disappear by the 19th (Friday). The risk of solar flares was very low.



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

3.2.6 Radiation Backround

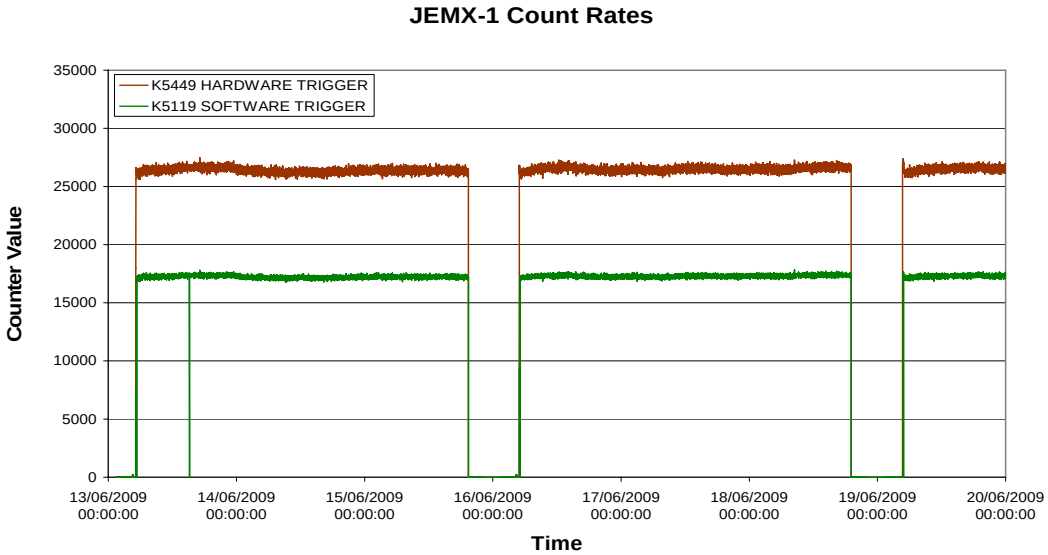
The background radiation level as measured by the instrument counters was low during the reporting period. The following plots show the SPI ACS, IBIS VETO, JEM-X Triggers and IREM count rates over the week:



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

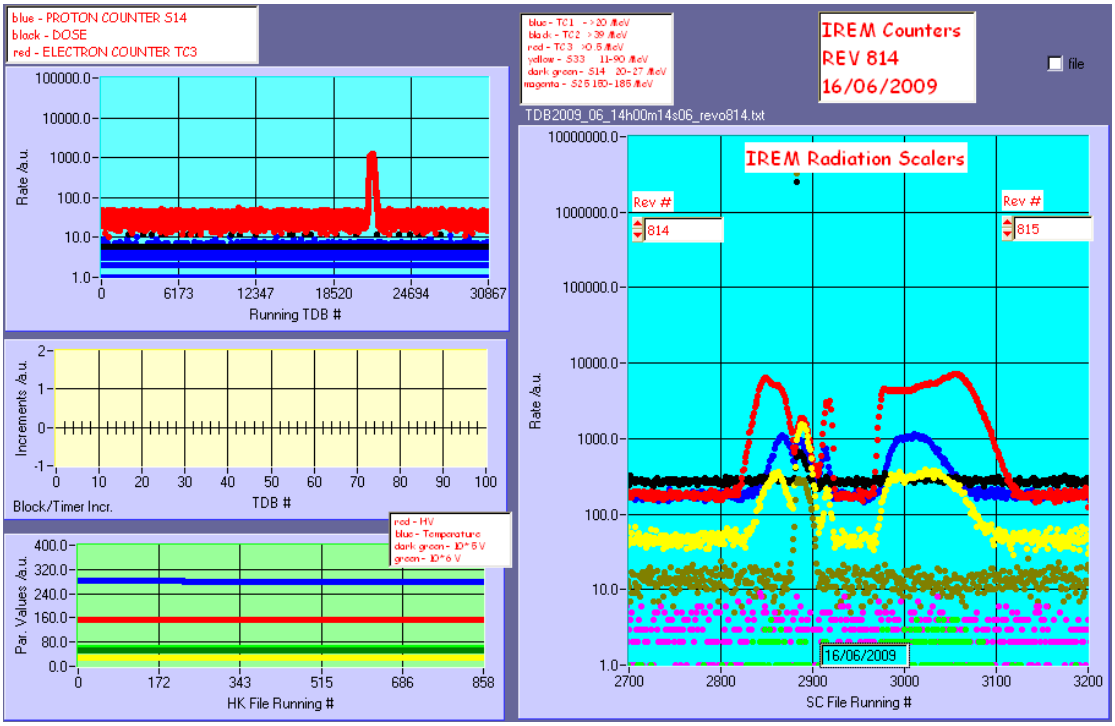
JEM-X Count Rates

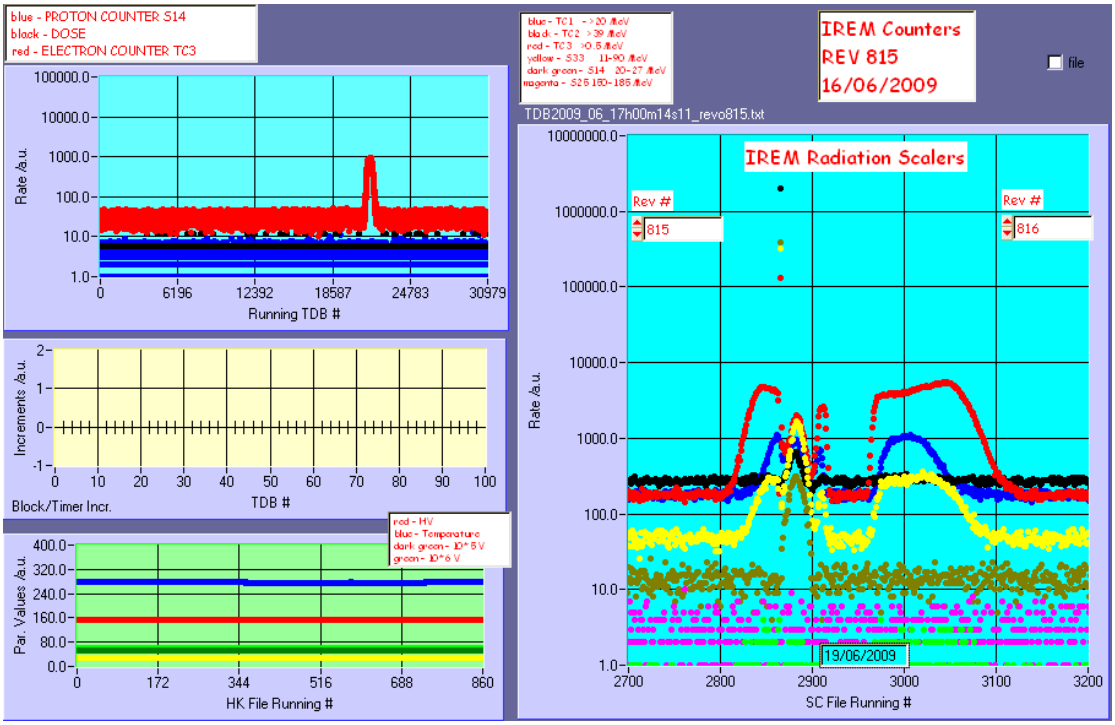
JEM-X count rates over the reporting period are displayed in the following graph[1].



[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 over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was very good this week, there was 1 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 good this week, there were three occasions of bad frames from Redu. The only impact was that one slew update failed which was updated manually.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

An updated PSF has been received for revolution 818, while first-time PSFs where received for revolutions 819-823. Replanning was done for revolutions 816-818. New planning was done for revolution 819.

New TSFs have been received for revolutions 815-817.

2. Observation status

New ECS files have been received for revolutions 801-803.

3. ISOC Science Data Archive

Testing of the beta release of ISDA 3.0 is still ongoing.

4. ISOC system

No news.

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
INT_SC-259	2009-06-16	IREM Anomaly: Reset of IREM_CSCI S/W #78, 09/06/2009	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, 13/06/2009 – 19/06/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 94 Open Loop Slews, 58 Closed Loop Slews and 7 Momentum Biases were executed (as reported by ACC OEM).

No slew was missed from the TL

The OTF was not reached during part of PIDs 08140011, 08150025 and 08150034.

Orbit Control

No update.

Fuel consumption

No update

The RMU-A null bias calibration

No update

13/06/2009 (Day of Year 164 , Revolution 813 to 814)

IMU switched ON during the stable pointing of PREQ 08140011 (14:32:00Z). A mapping was commanded and the parameter for the next slew updated.

No impact on the Timeline

14/06/2009 (Day of Year 165 , Revolution 814)

Nothing to report

15/06/2009 (Day of Year 166 , Revolution 814)

Nothing to report

16/06/2009 (Day of Year 167 , Revolution 814 to 815)

Nothing to report

17/06/2009 (Day of Year 168 , Revolution 815)

- IMU switched ON during the stable pointing of PREQ 08150025 (02:21:00Z). A mapping was commanded and the parameter for the next slew updated.

No impact on the Timeline

- IMU switched ON (11:22:00Z) during the stable pointing of PREQ 08150034. Since the time the IMU was in the control loop was in the order of a minute, the subsequent CGS was let go without further update and it worked OK.

No impact on the Timeline

18/06/2009 (Day of Year 169 , Revolution 815)

TPF update failed for PREQ 08150060 because of a TM drop. A mapping was commanded and the update was done manually.

No impact on the Timeline

19/06/2009 (Day of Year 170 , Revolution 815 to 816)

Nothing to report

8.2.2 SPI Operations

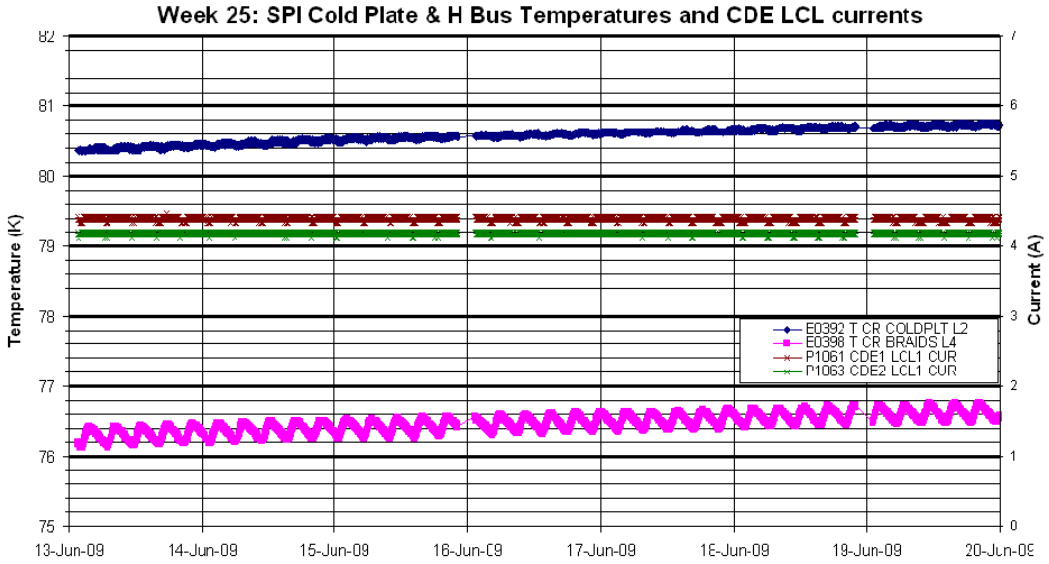
Unit Temperatures: All the equipment temperatures are inside the operational limits.

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

- CDE1 LCL Current = 4.39A
- CDE2 LCL Current = 4.17A

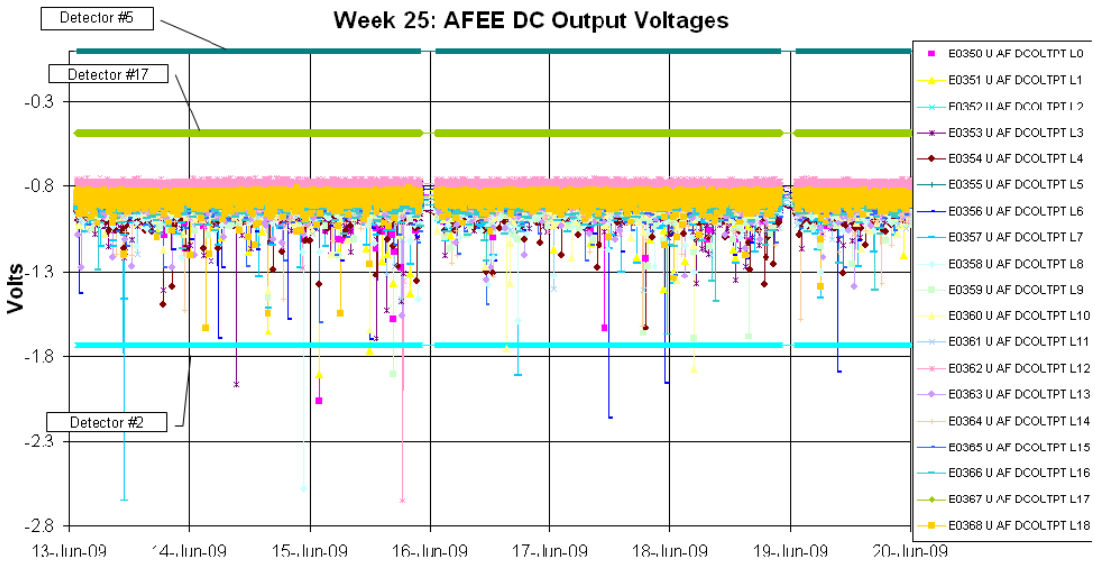
The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period:



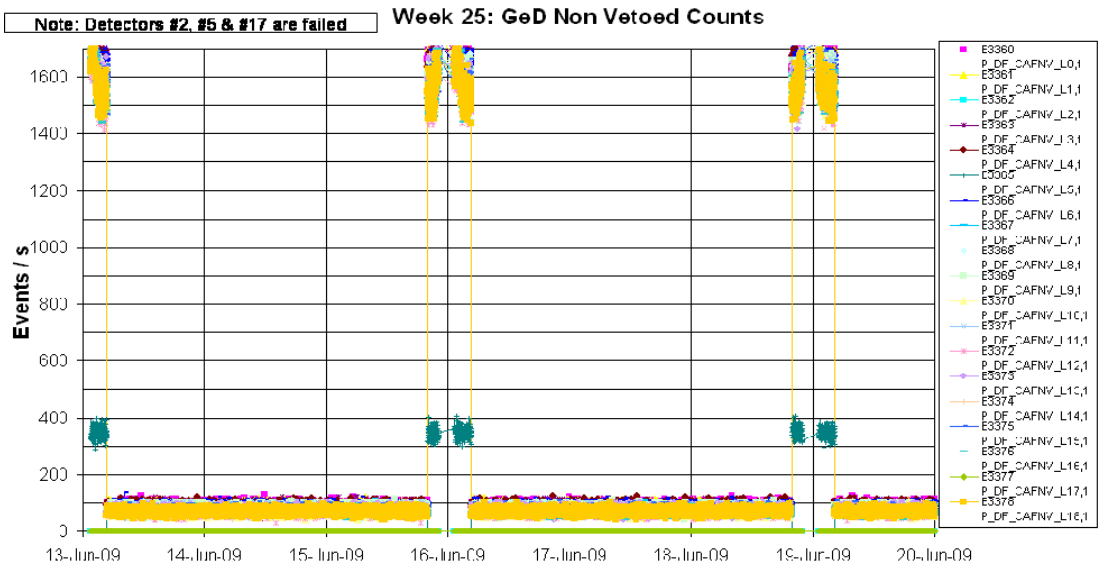
DPE & IASW: The DPE health and IASW performance are nominal. The IASW version installed is v4.3.4 with SE compression only enabled and the spectra scaling factor set to 8/19 SE. The DPE CPU usage was nominal during the reporting period (see plot in Section 3.2.1).

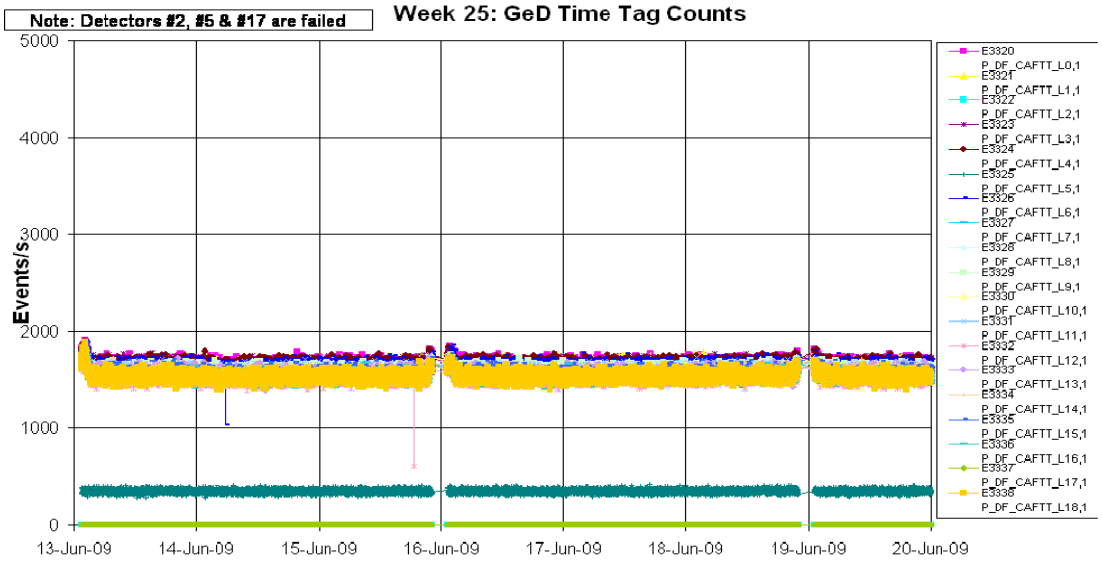
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

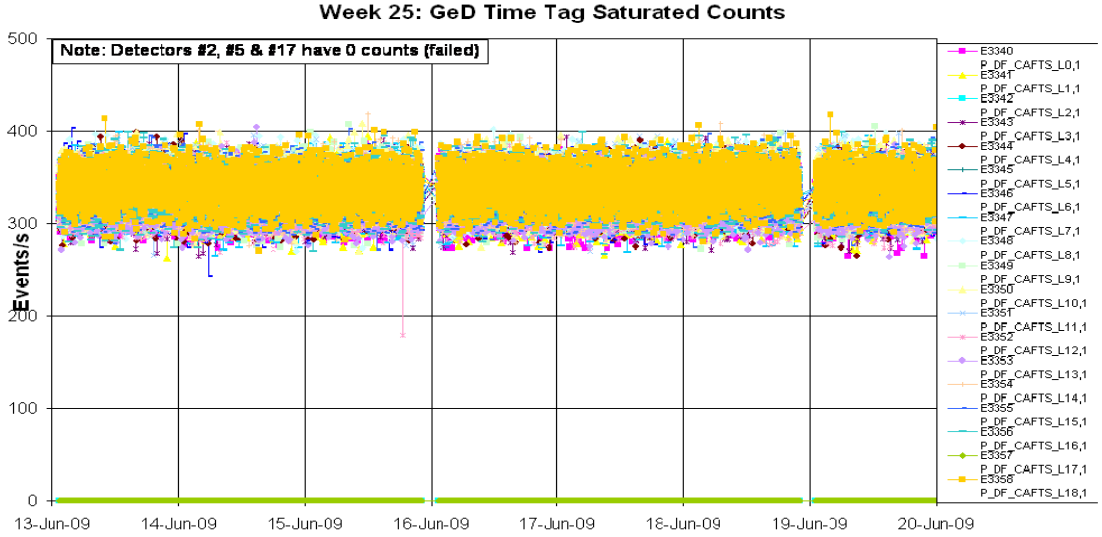
AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the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



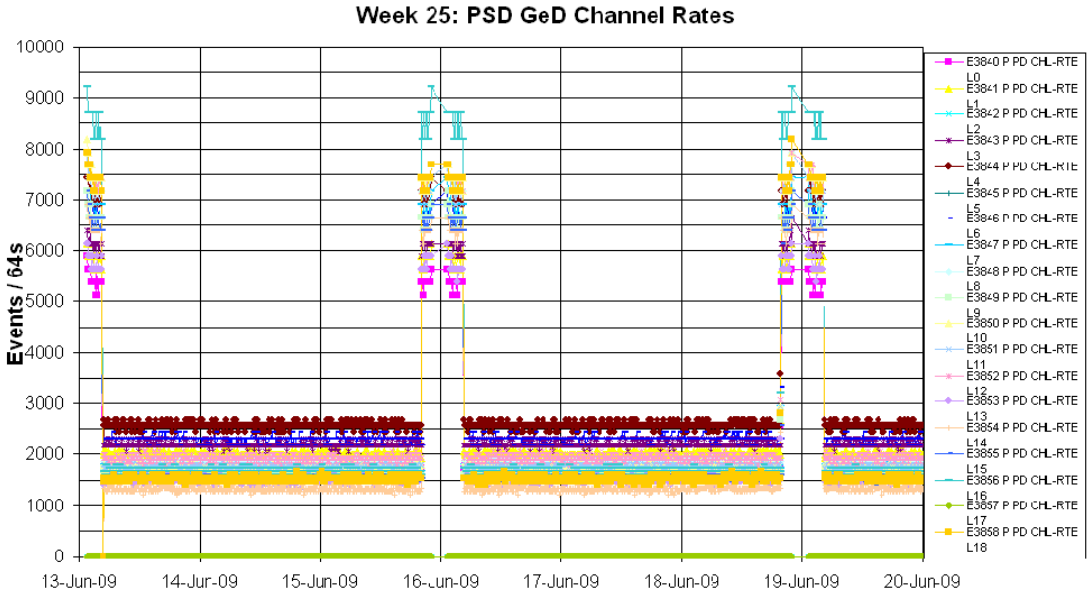
DFEE: The health of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period.







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



Event Log:

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

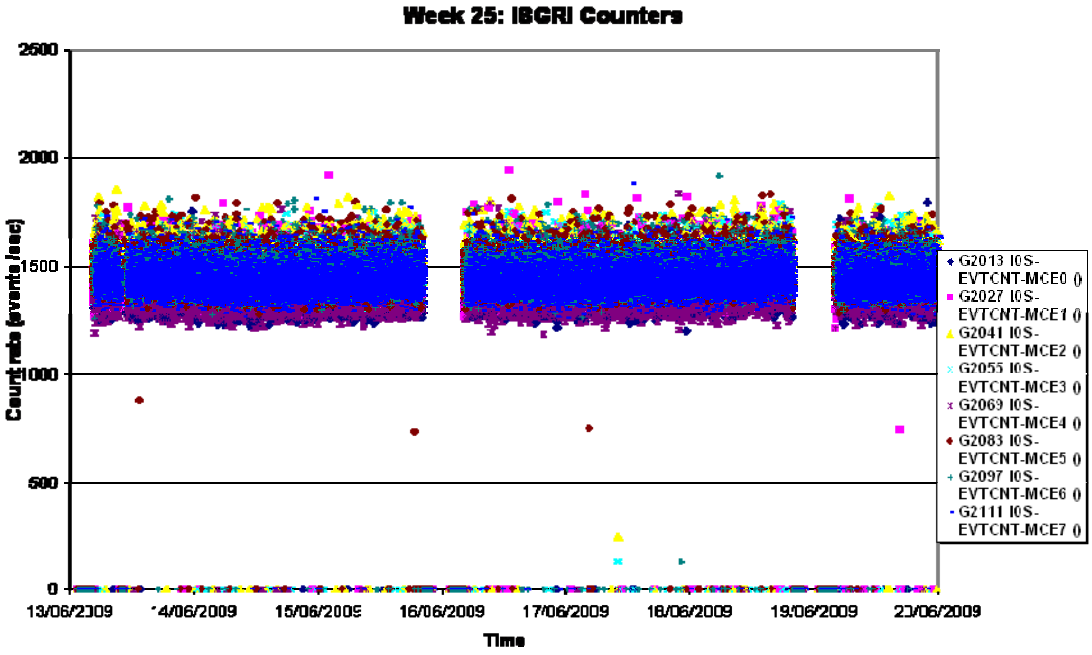
- On 2009-06-14 at 02:22:29Z TM parameter T8601 LCL STA CAM HT-B (SPI Camera Heater B LCL Status) spontaneously changed state from CLOSE to OPEN. At the next TM cycle (02:22:37Z) TM parameter P2161 P BD2B GSW2 STA (PPDU Board 2B GSW 2 Status) was also reported as changed from CLOSE to OPEN. Status Consistency Check alarms were therefore received for both parameters. As T8601 LCL CAM HT-B is powered through P2161 P BD2B GSW2, this was likely due to an SEU on the PPDU Board 2B GSW 2, which would cause the reported status of the LCLs powered through it to also change to OPEN. Following the recovery action specified for TM parameter P2161, it was determined that the other LCLs powered through PPDU Board 2B GSW 2 (i.e. P2162 LCL STA OMC EU B and P2163 LCL STA ODPE B) were not affected as they were previously OPEN (as nominal). The following recovery actions were then performed:
  - At 02:34:46Z TC P4327 (P BD2B GSW2 ON A) was sent to switch on the PPDU Board 2B GSW 2.
  - At 02:35:39Z the relevant step of FCP_TCS_1106 (Adjust SPI Camera Heater B thermal control) was executed (TC T5106 LCL CAMER H-B ON) to switch on SPI Camera Heater B.

  The commands were successful, clearing the SSC failures on both the TM parameters P2161 and T8601. Operations continued nominally. This is recorded as Anomaly Report INT_SC-262.
- On 2009-06-17 at 14:20:07Z OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED with parameter E9780 (DETECTOR ID) = 16. As this was a single occurrence, no action was taken.

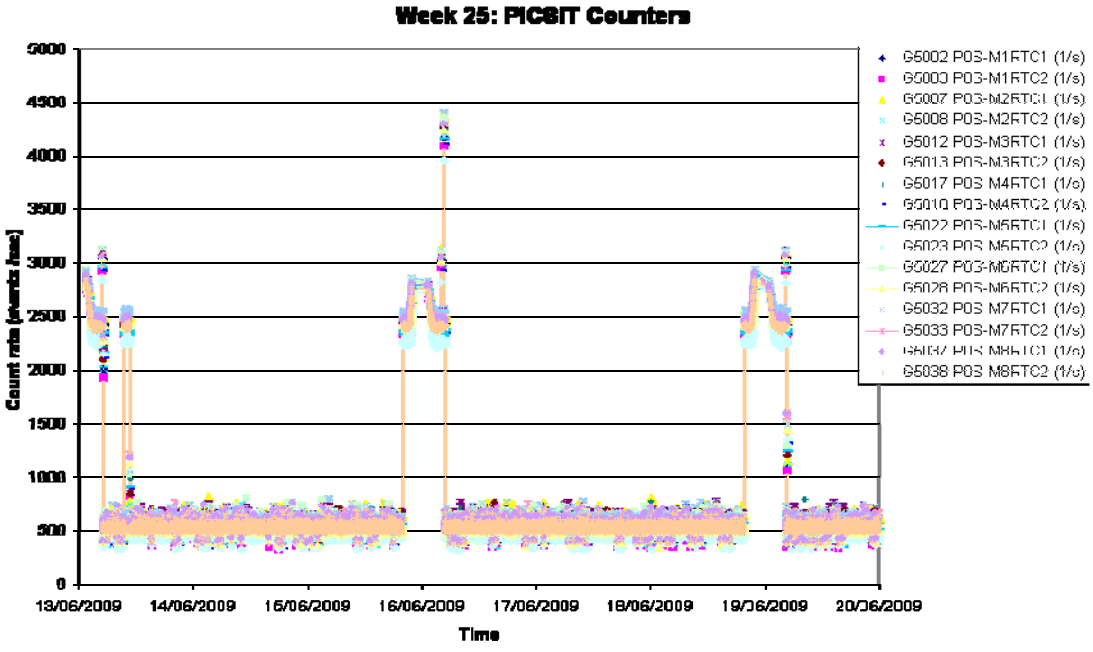
8.2.3 IBIS Operations

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:

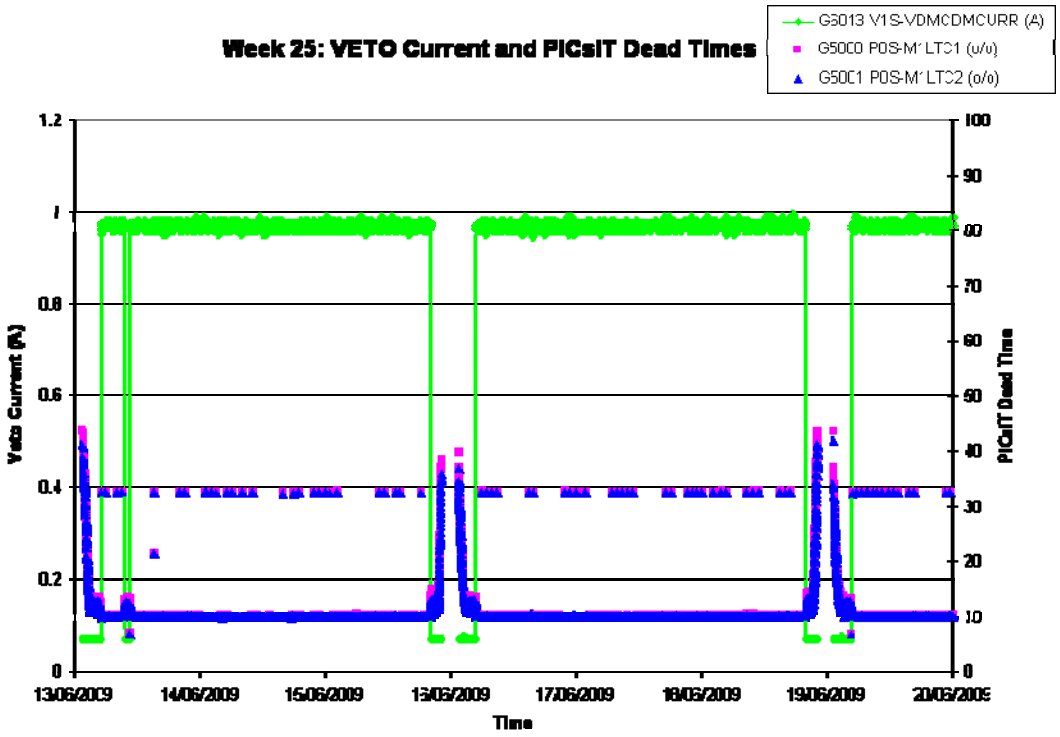


PICsIT
The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week:



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 (P0S-Mi_RTC1) and G5003 (P0S-Mi_RTC2) families and G2000 family (I0E-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 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.

2009-06-13 (DOY 164, Rev 814)

Due to an IREM SEU, IBIS transitioned autonomously to Safe configuration at 09:31:28Z. It was recovered as follows:
- At 10:32:51Z FCP_IBIS1_0803 IBIS EXIT FROM SAFE MODE
- At 10:53:34Z ED GESTAN02 uplinked with the planned observation parameters and commanding to IBIS from the Timeline re-enabled.

IBIS operations continued nominally.

2009-06-14 (DOY 165, Rev 814) to 2009-06-17 (DOY 168, Rev 815)

IBIS operations executed nominally.

2009-06-18 (DOY 169, Rev 815-816)

At 08:29:32Z TM parameters G6062, G6063 (VETO bottom and lateral counters respectively) went OOL Warning High. As they returned within limits of their own accord at the next TM cycle, no action was taken.

At 11:00Z, 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:
- 12:19:37Z FCP_IBIS1_0312
- 12:29:20Z TC G0129 uplinked to return IBIS to Science Standard mode.

IBIS operations continued nominally.

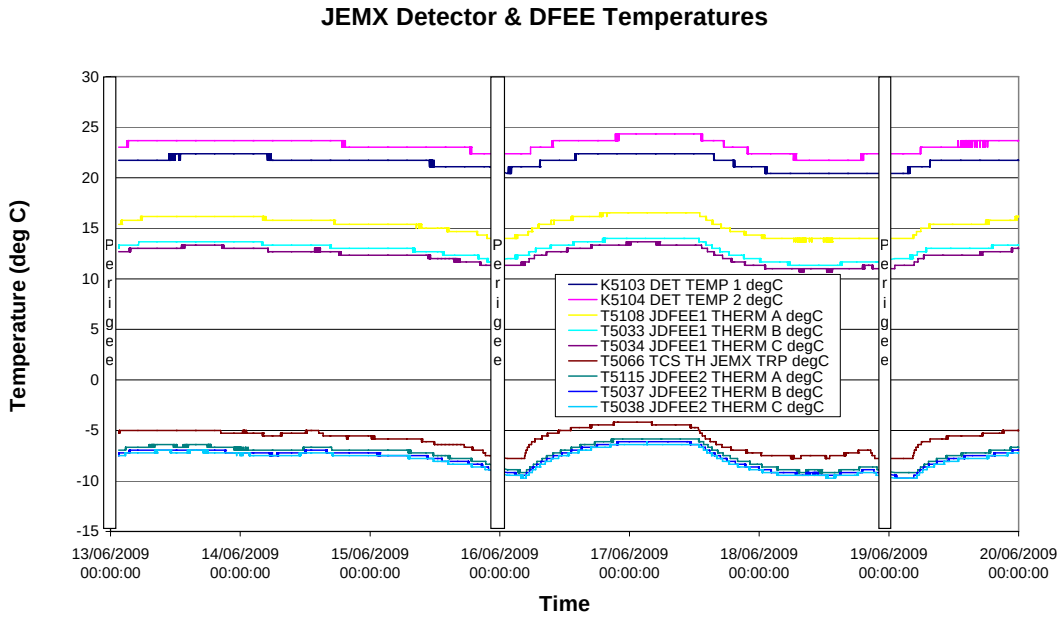
2009-06-19 (DOY 170, Rev 816)

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 graph[2].



[2] Data sampled (1 frame in 8)

JEM-X Daily Report

2009-06-13 (DoY 164 Rev 814)

At 09:32:02 JEMX parameters K5315, K5316 & K5317 went Out-of-Limits due to an IREM SEU (#79). There was no impact as the reaction has been disabled.

2009-06-14 (DoY 165 Rev 814) to 2009-06-15 (DoY 166 Rev 814)

JEM-X 1 operations executed nominally.

2009-06-16 (DoY 167 Rev 815)

At the indicated times, the following OEMs were received:

```
2009.167.05.07.15.478   2009.167.05.07.19.115   1536   RealTime   5       EXCEPTION
JEM-X1 EXC IACS INTERF EXID                              0       0    65535   PR    N
E   E
    FIX6                                            0
    K9079          MESS CLASS                       1
    K9080          MESS ID                          5
    K9065          CSSW OPERAT ID                   START
    K9066          TASK ID 8                        IASW
    K9067          LOGICAL ADDRESS                  4989
2009.167.05.07.15.478   2009.167.05.07.19.124   1536   RealTime   6       EXCEPTION
JEM-X1 EXC IACS INTERF CULP                              0       0    65535   PR    N
E   E
    FIX6                                            0
    K9079          MESS CLASS                       1
    K9080          MESS ID                          6
    K9065          CSSW OPERAT ID                   START
    K9066          TASK ID 8                        IASW
    K9067          LOGICAL ADDRESS                  19726
```

No action was taken, and there was no impact.

2009-06-17 (DoY 168 Rev 815)

JEM-X 1 operations executed nominally.

2009-06-18 (DoY 169 Rev 815)

At the indicated times, the following OEMs were received:

```
2009.169.04.21.49.587   2009.169.04.21.54.331   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                            0
    K9079          MESS CLASS                       2
    K9080          MESS ID                          5
    K9074          TASK ID 16                       12
    K9067          LOGICAL ADDRESS                  4989
2009.169.04.21.49.587   2009.169.04.21.54.390   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                            0
    K9079          MESS CLASS                       2
    K9080          MESS ID                          5
    K9074          TASK ID 16                       12
    K9067          LOGICAL ADDRESS                  4989
```

```
2009.169.04.21.49.587   2009.169.04.21.54.391   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                        0
    K9079          MESS CLASS                   2
    K9080          MESS ID                      5
    K9074          TASK ID 16                   12
    K9067          LOGICAL ADDRESS              4989
2009.169.04.21.49.587   2009.169.04.21.54.392   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                        0
    K9079          MESS CLASS                   2
    K9080          MESS ID                      5
    K9074          TASK ID 16                   12
    K9067          LOGICAL ADDRESS              4989
2009.169.04.21.49.587   2009.169.04.21.54.393   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                        0
    K9079          MESS CLASS                   2
    K9080          MESS ID                      5
    K9074          TASK ID 16                   12
    K9067          LOGICAL ADDRESS              4989
2009.169.04.21.49.587   2009.169.04.21.54.393   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                        0
    K9079          MESS CLASS                   2
    K9080          MESS ID                      5
    K9074          TASK ID 16                   12
    K9067          LOGICAL ADDRESS              4989
2009.169.04.21.49.587   2009.169.04.21.54.394   1536   RealTime   5
ANOMALY     JEM-X1 CSSW INT ER EXCEPTIO
0       0    65535   PR    N     E   E
    FIX6                                        0
    K9079          MESS CLASS                   2
    K9080          MESS ID                      5
    K9074          TASK ID 16                   12
    K9067          LOGICAL ADDRESS              5336
```

No action was taken, and there was no impact.

2009-06-19 (DoY 170 Rev 816)

JEM-X 1 operations executed nominally.

8.2.5 OMC Operations

2009-06-13 (DoY 164, Rev 814)

At 09:31:18, an IREM SEU (#79) forced OMC to SAFE mode, a recovery was performed, and the unit returned to standby at 10:17:01. The impact was the interruption after 1476 from a planned 3479 seconds of pointing 08140006, and the loss of pointing 08140007.

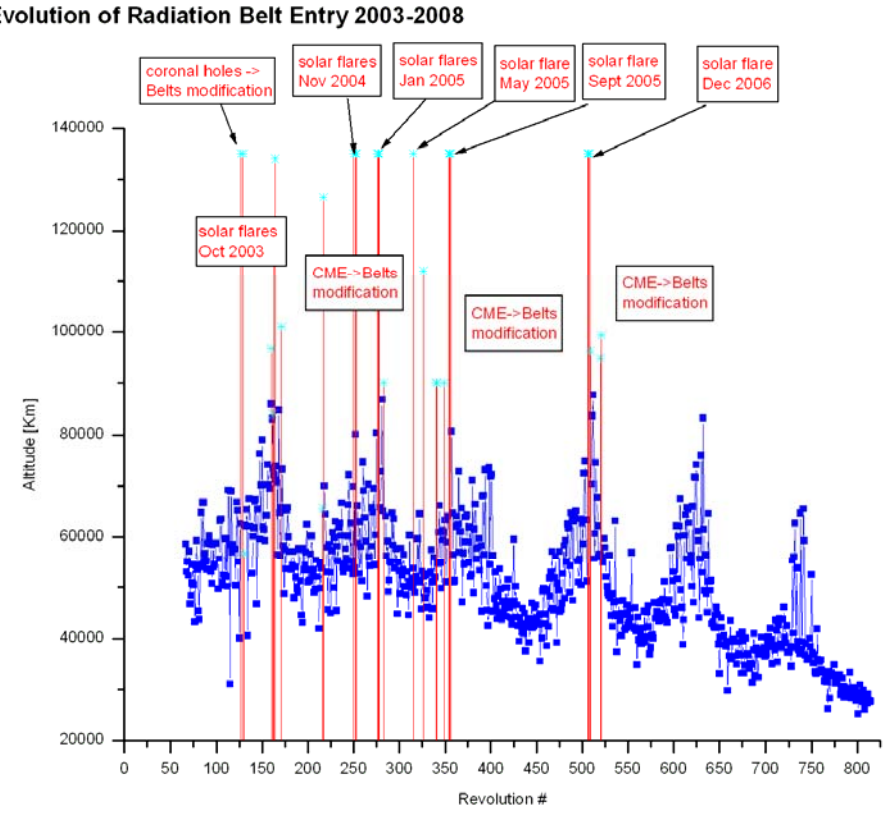
2009-06-14 (DoY 165, Rev 814) to 2009-06-19 (DoY 170, Rev 816)

Nothing to report.

On DoY 166 at 20:03:03 and DoY 169 at 19:49:59 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

DoY 2009.164 (13/06/2009):

At 09:31:17Z, a local reset of the IREM CSCI S/W (SEU #79) occurred. The status of the unit, before the local reset of the IREM CSCI S/W, was nominal, here is a summary:

1) The temperatures were nominal;
2) The LCL current was nominal;
3) The last HK before the anomaly showed HV, 5V and 6V voltages inside limits;
4) The anomaly occurred at 2009.164.09.31:17Z (89580.5 km). The unit had performed an automatic transition to Standard Mode (ie. no block counter increasing, all the TM words= FFFF hex); just before the anomaly, radiation counters reported nominal values considering the position of the S/C along the orbit;
5) The recovery of the unit started immediately using procedure CRP_SYS_2570. The first dump of the status word after the anomaly reported a value of BCC0 HEX =

48320 DEC = 1011110011000000, i.e the Checksum Failure Flag ON. The unit was still reporting the status as if it was in Integral mode with counting ON and accumulation ON. This value of the status word is assumed to be an old one written by the S/W at the moment of the anomaly.
6) The patch was performed successfully with the correct re-starting of the S/W following procedure FCP_RM_0081. The operation was completed at 12:20:00Z.

The IREM automatic transition to Standard Mode affected the instruments by forcing them to automatically enter Safe configuration, except for SPI and JEM-X whose automatisms are disabled according to the PIs request. OMC was recovered at 10:17:01Z and IBIS at 10:55:00Z.

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]
814	RAD_EXIT R 2009-06-13T04:47:07Z	13/06/2009 02:56:13	>>32731.2	13-Jun-2009 03:38:24	46967.17
814	RAD_ENTR R 2009-06-15T20:03:00Z	15/06/2009 21:34:21	27506.8	15-Jun-2009 21:18:24	31708.59
815	RAD_EXIT R 2009-06-16T04:34:55Z	16/06/2009 02:34:45	>>32715.5	16-Jun-2009 03:38:24	47099.19
815	RAD_ENTR R 2009-06-18T19:49:53Z	18/06/2009 21:20:14	27732.2	18-Jun-2009 20:57:59	30965.59
816	RAD_EXIT R 2009-06-19T04:21:27Z	19/06/2009 02:17:58	>>32732.9	19-Jun-2009 03:17:59	47794.19

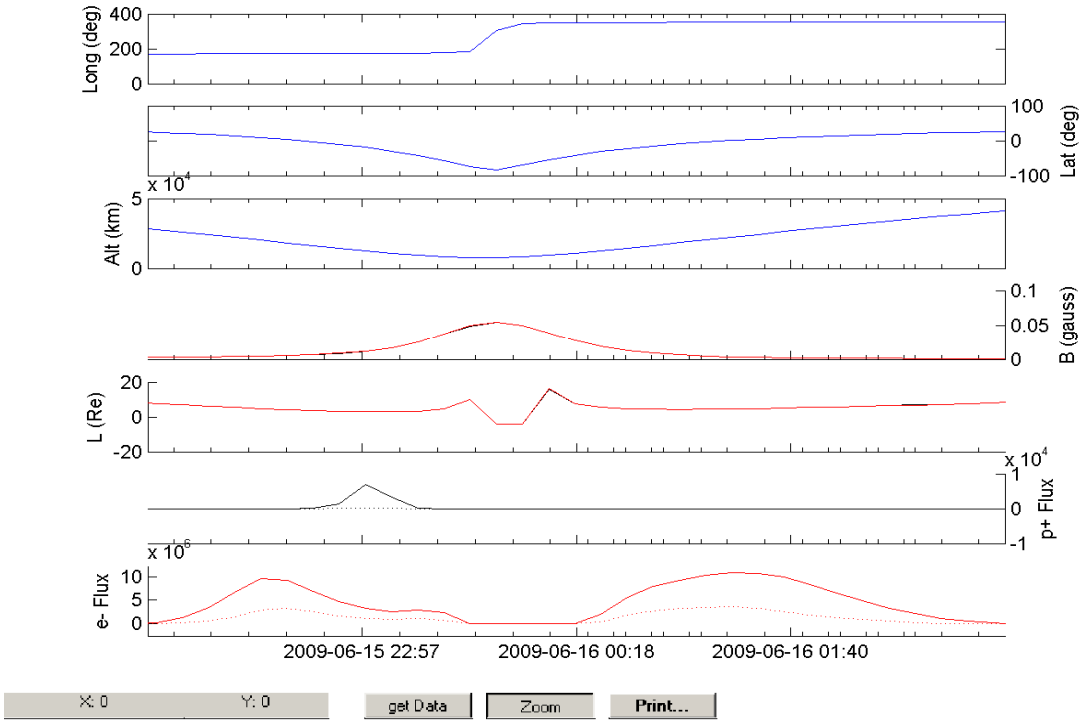
Reference
High radiation
Very small error vs reference (less than 10 minutes)
Small error vs reference (between 10 and 30 minutes)
Large error vs reference (more than 30 minutes)
* Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM radiation counters:

The IREM radiation counter plots are not available this week.

IREM Predicted Radiation Belt Passages

Rev 814



Rev 815