

**INTEGRAL**  
**Mission Report**  
**INT-MOC-SYS-RP-1001-OPS-OAI**  
**No. 356**  
**Week 29**  
**20.07.09**  
**Routine Phase**

Prepared by: F. Schmidt (OPS-OAI) and INTEGRAL FCT

## LIST OF CONTENTS

|       |                                                              |    |
|-------|--------------------------------------------------------------|----|
| 1     | General.....                                                 | 3  |
| 2     | Summary of Activities.....                                   | 3  |
| 3     | Satellite Status.....                                        | 3  |
| 3.1   | Platform.....                                                | 3  |
| 3.1.1 | AOCS.....                                                    | 3  |
| 3.1.2 | Power.....                                                   | 3  |
| 3.1.3 | Thermal.....                                                 | 3  |
| 3.1.4 | OBDH.....                                                    | 3  |
| 3.1.5 | RFS.....                                                     | 4  |
| 3.2   | Payload.....                                                 | 4  |
| 3.2.1 | SPI.....                                                     | 4  |
| 3.2.2 | IBIS.....                                                    | 5  |
| 3.2.3 | JEM-X.....                                                   | 7  |
| 3.2.4 | OMC.....                                                     | 7  |
| 3.2.5 | IREM.....                                                    | 7  |
| 3.2.6 | Radiation Background.....                                    | 8  |
| 4     | Ground Facilities.....                                       | 10 |
| 4.1   | Mission Operations Centre.....                               | 10 |
| 4.2   | Ground Stations & Network.....                               | 10 |
| 4.3   | Science Ground Segment.....                                  | 10 |
| 5     | Special Events.....                                          | 11 |
| 6     | Anomalies.....                                               | 11 |
| 7     | Future Milestones.....                                       | 11 |
| 8     | Appendix.....                                                | 12 |
| 8.1   | Consumables.....                                             | 12 |
| 8.2   | Detailed Satellite Information.....                          | 12 |
| 8.2.1 | AOCS SUMMARY OPERATIONS REPORT, 11/07/2009 – 17/07/2009..... | 12 |
| 8.2.2 | SPI Operations.....                                          | 13 |
| 8.2.3 | IBIS Operations.....                                         | 17 |
| 8.2.4 | JEM-X Operations.....                                        | 19 |
| 8.2.5 | OMC Operations.....                                          | 20 |
| 8.2.6 | IREM Operations.....                                         | 21 |

## DISTRIBUTION LIST

| Addressees           | Copy | Addressees            | Copy |
|----------------------|------|-----------------------|------|
| D/OPS                |      | ESAC                  |      |
| G. Winters D/OPS     | 1    | P. Kretschmar         | 1    |
| J. F. Kaufeler OPS-G | 1    | M. Kessler SCI-O      | 1    |
| N. Bobrinsky OPS-ON  | 1    | E. Kuulkers           | 1    |
| A. Rudolf OPS-OA     | 1    | K. Engan              | 1    |
|                      |      | A. Parmar SRE-OA      | 1    |
|                      |      |                       |      |
| M. Kirsch            | 1    | ESTEC/SCI-A           |      |
| R. Southworth        | 1    | Nicola Rando          | 1    |
| F. Di Marco          | 1    |                       |      |
| F. Cordero           | 1    | ESA HQ                |      |
| M. Walker            | 1    | D. Southwood D/SRE    | 1    |
| S. DePadova          | 1    |                       |      |
| S. Fahmy             | 1    | ESTEC                 |      |
| F. Schmidt           | 1    | J. Ellwood SRE-P      | 1    |
| C. Lozano            | 1    |                       |      |
| D. Webert            | 1    | ESTEC / PG            |      |
| M. Panteleoni        | 1    | G. Sarri              | 1    |
| J. Martin            | 1    |                       |      |
| U. Weissmann         | 1    | ESTEC/RSSD            |      |
| N. von Krusenstiern  | 1    | C. Winkler            | 1    |
|                      |      |                       |      |
| A. Mantineo          | 1    |                       |      |
| K. Scott             | 1    | ISDC                  |      |
|                      |      | R. Walter             | 1    |
|                      |      | ISDC Shift Team       | 1    |
| SPACONs              | 1    |                       |      |
| I. Bayliss           | 1    | ALENIA                |      |
| G. Di Girolamo       | 1    | M. Montagna           | 1    |
| F. Dreger            | 1    | F. Ravera             | 1    |
| G. Gienger           | 1    |                       |      |
| S. Pallaschke        | 1    | PI / Instrument Teams |      |
| W. Hell              | 1    | J. P. Roques – SPI    | 1    |
| K.J. Schulz          | 1    | G. La Rosa – IBIS     | 1    |
| M.A. Larsen          | 1    | P. Ubertini – IBIS    | 1    |
|                      |      | A. Bazzano - IBIS     | 1    |
| M. Butkovic          | 1    | F. Lebrun - IBIS      | 1    |
| D. Heinzer           | 1    | S. Brandt – JEM X     | 1    |
| U. Feucht            | 1    | E. De Miguel - OMC    | 1    |
| Shift – Coord        | 1    | W. Hajdas – IREM      | 1    |
| Scheduling Office    | 1    |                       |      |
| T. Beck              | 1    | JPL / Goldstone       |      |
| M. Rossmann          | 1    | D. Holmes             | 1    |
| M. Unal              | 1    | J. Valencia           | 1    |
| P. Maldari           | 1    | Jesse Velasco         | 1    |
|                      |      | Julia Bell            | 1    |
|                      |      | DSN - MPSETD          | 1    |
| Redu                 |      |                       |      |
| B. Demellenne        | 1    |                       |      |

## **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 11.07.09 until 17.07.09 (both dates inclusive) and covers the revolutions 823 and 824.

## **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 the Coma Cluster (RA 12:59:48.70, +27:58:50.0) and a raster dither of the North Ecliptic Pole (RA 18:00:00.00, +66:33:39.0).

*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.

Slew 08240048 was missed from the TL, during the observation period.

The fuel consumption over the period between 11/07/2009 and 17/07/2009 was 0.0789 Kg. The remaining propellant is in the order of 133.3397 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

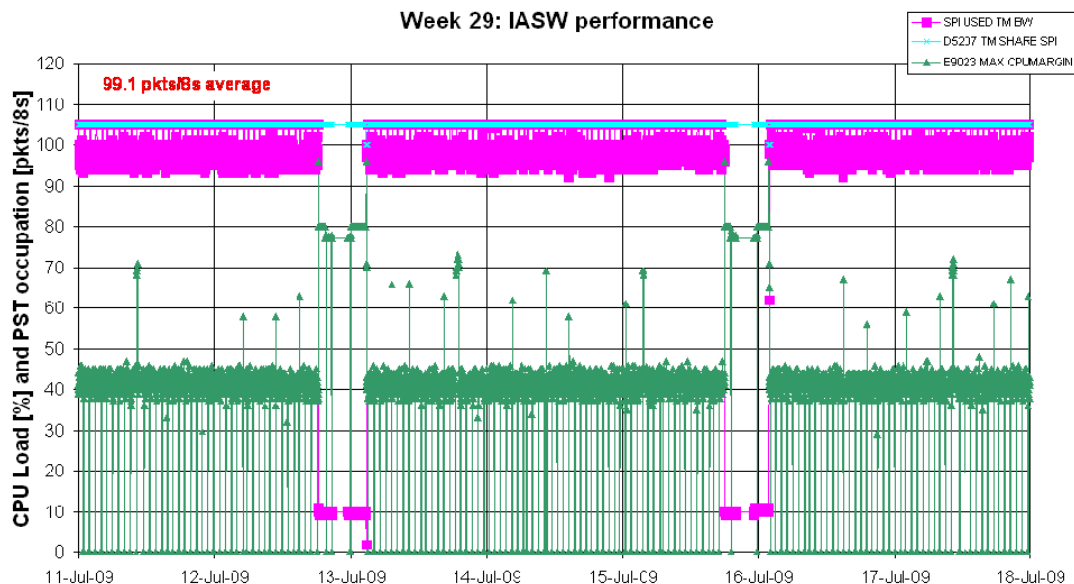
### 3.2.1 SPI

Following the 13<sup>th</sup> 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.

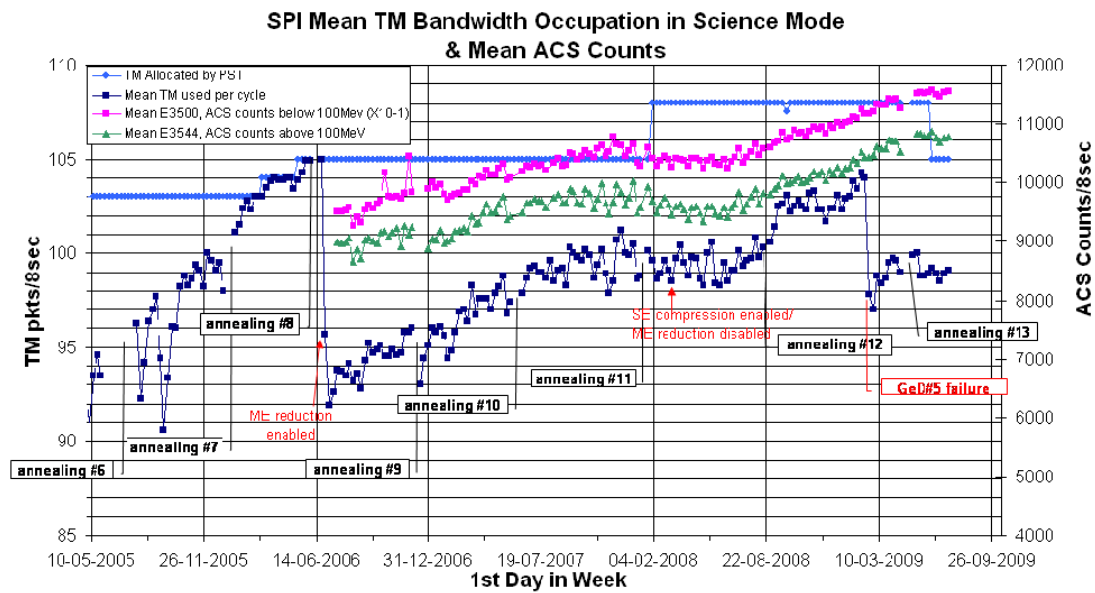
SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle and the average telemetry occupation was 99.1 packets/cycle.

The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period<sup>1</sup>:



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.

<sup>1</sup> Data sampled every 8<sup>th</sup> 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.

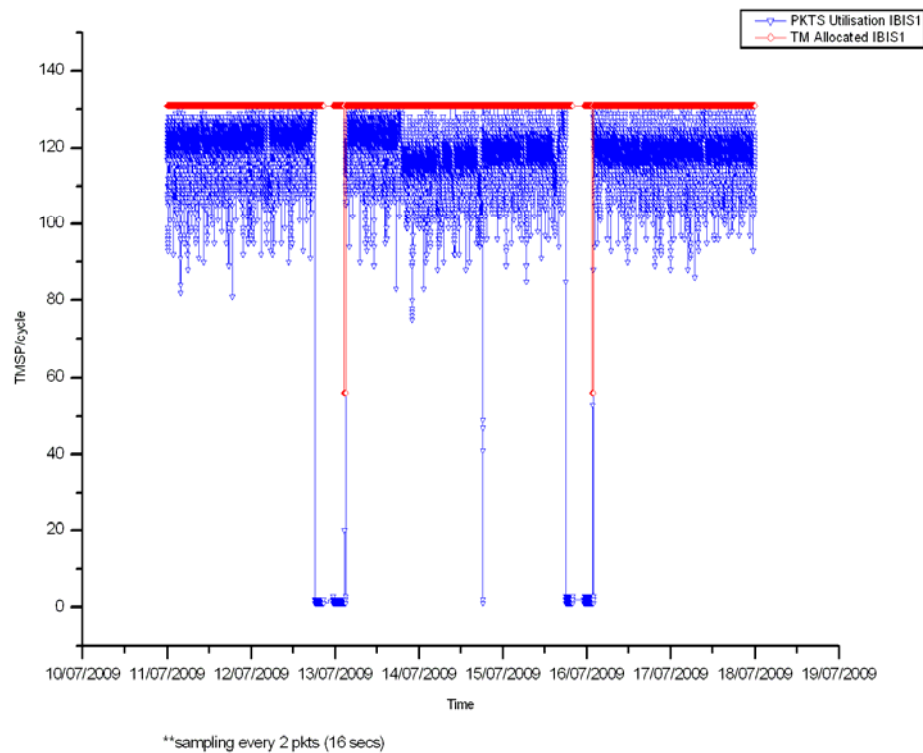
During the reporting period, IBIS was operated in Science Standard mode during science observations. The TM bandwidth statistics were as follows:

- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 118.96 packets/cycle (down 1.89 on previous week)
- Percentage of TM cycles for which bandwidth usage was 131 packets/cycle: 0.86%

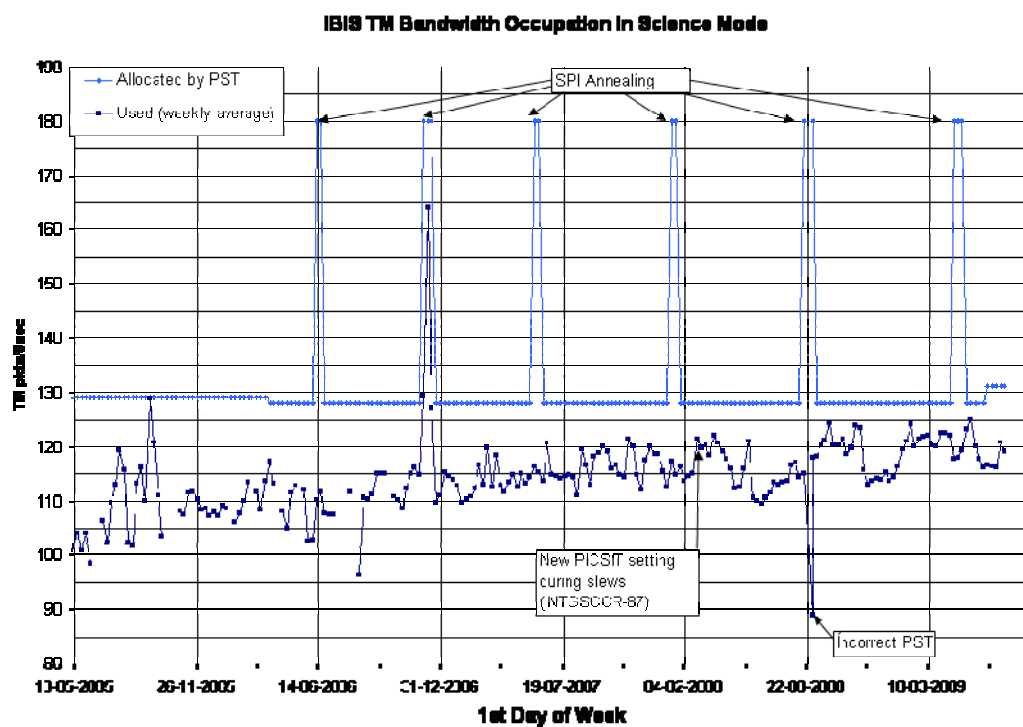
The plot below shows the IBIS TM utilisation during the reporting period<sup>2</sup> :

<sup>2</sup> Data sampled every 2<sup>nd</sup> packet (16sec)

IBIS - TM Bandwidth Utilisation Rev 823-825



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, 142 of the 143 planned science pointings were executed nominally, one pointing was lost.

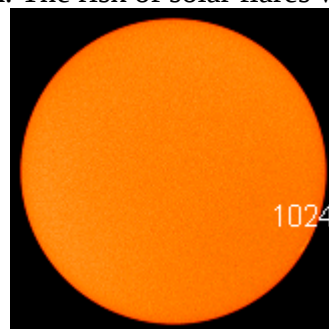
*Note: Some more information concerning the OMC operations is provided in the Appendix.*

### **3.2.5 IREM**

The overall status of the unit is nominal.

#### **Solar Activity**

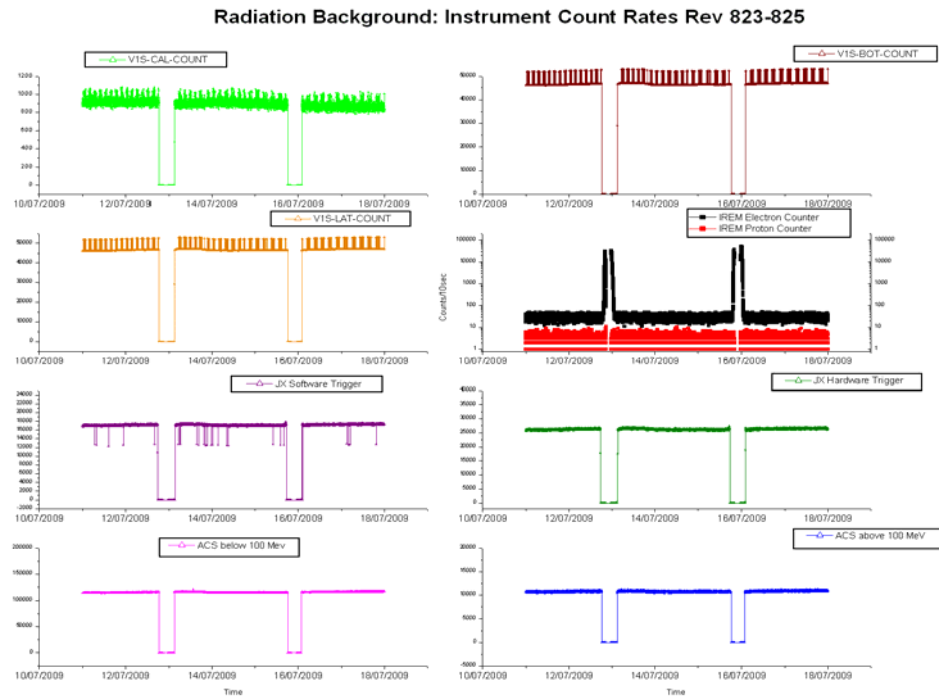
The observation period was characterised by low solar activity. Sun-spot #1024 was present on the 11<sup>th</sup> July, but had disappeared by the following day. For the remainder of the week, the sun was blank. The risk of solar flares was very low.



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

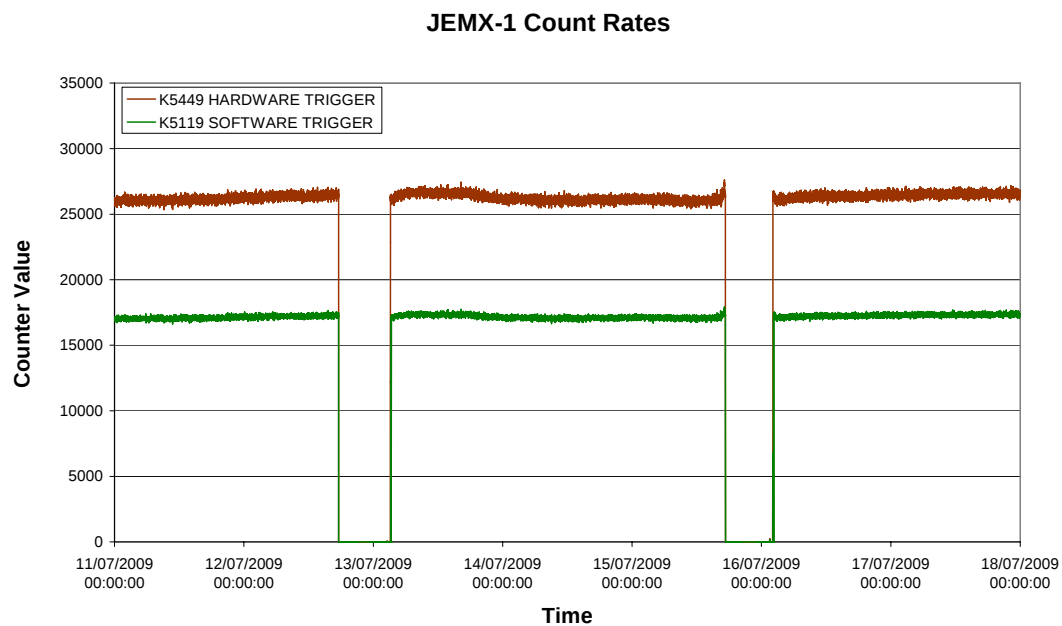
### 3.2.6 Radiation Background

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<sup>3</sup> :



### JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph<sup>4</sup>.

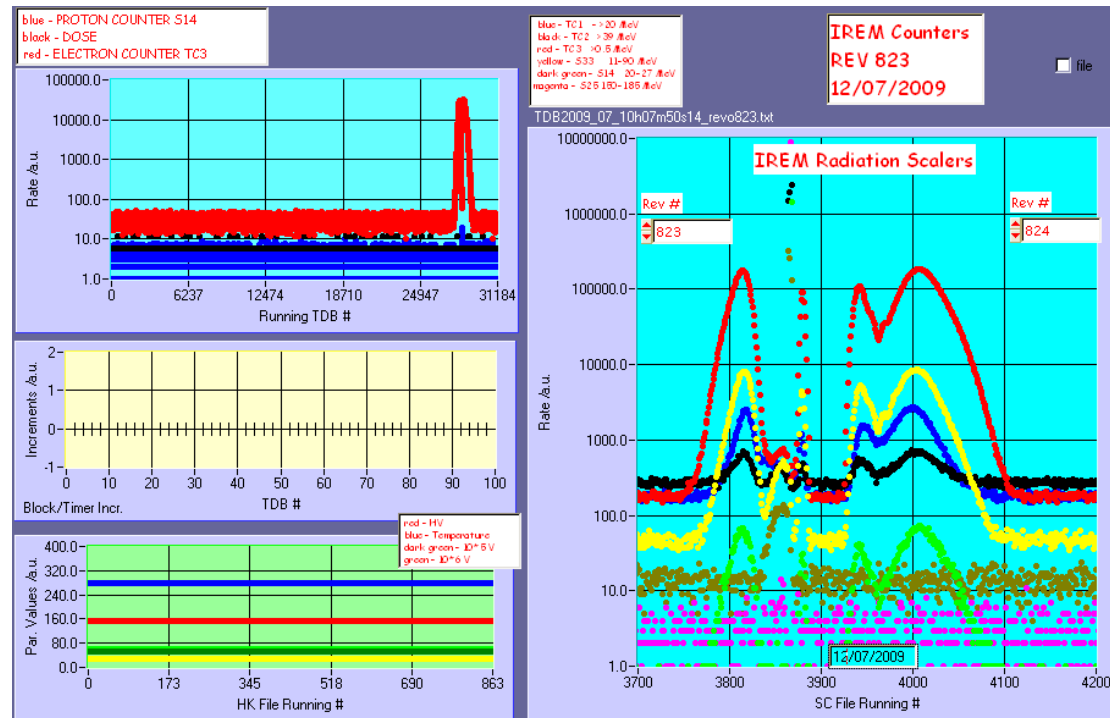


<sup>3</sup> Data sampled every 6<sup>th</sup> packet (48sec)

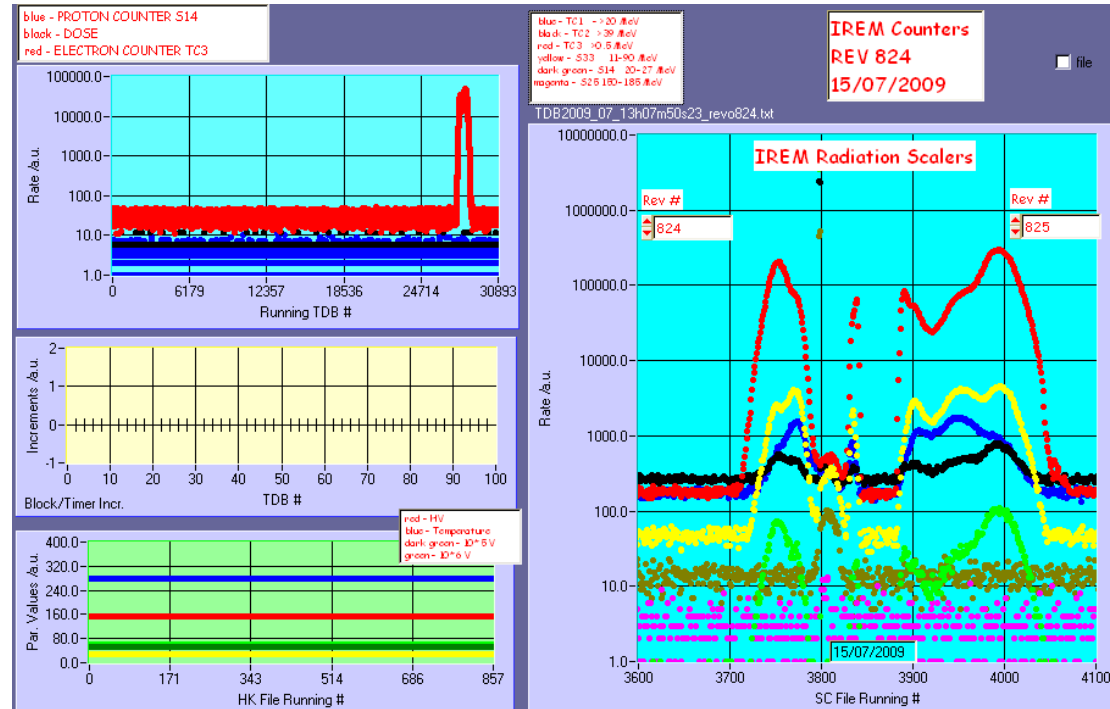
<sup>4</sup> Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

## IREM radiation counters:

### Revolution 823



### Revolution 824



## **4 Ground Facilities**

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

### **4.1 Mission Operations Centre**

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

### **4.2 Ground Stations & Network**

The performance of the ground stations and Network was good this week, there were 5 occasions of bad frames, 22 occasions of a TM drop VC0 and VC7 from Redu. There was one occasion of a TC drop from DSS27. There was no impact on T/L operations.

### **4.3 Science Ground Segment**

ISOC

#### **1. Mission planning**

New PSFs have been received for revolution 833 and 834. No new observations have been planned since there was still considerable margin ahead.

No new TSFs have been received - the last is for revolution 829.

#### **2. Observation status**

New ECS files have been received and processed for revolutions 809-813.

#### **3. ISOC Science Data Archive**

A second beta for ISAD 3.0 has been released with many issues fixed and tested again.

#### **4. ISOC system**

The new Webserver is ready and will be set up in week 30.

#### **5. Problems**

None.

## 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-3068 | 2009-07-14   | Degraded Performance at REDU | ESA Stations | 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, 11/07/2009 – 17/07/2009**

The AOCs operations were executed from the Automatic Timeline.

During this period, 93 Open Loop Slews, 57 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

Slew 08240048 was missed from the TL.

#### **Orbit Control**

No update.

#### **Fuel consumption**

No update

#### **The RMU-A null bias calibration**

No update

**11/07/2009 (Day of Year 192 , Revolution 823)**

Nothing to report

**12/07/2009 (Day of Year 193 , Revolution 823)**

Nothing to report

**13/07/2009 (Day of Year 194 , Revolution 823 to 824 )**

Nothing to report

**14/07/2009 (Day of Year 195 , Revolution 824)**

Nothing to report

**15/07/2009 (Day of Year 196 , Revolution 824)**

- CSL 08240048 failure due to a FALSE EVENT in star in slot #2 just before the execution of TC A3189 "START GUIDE STAR". This lead to a PTV failure at release time.

A manual slew was generated (spacontool) from PID 08240047 to PID 08240048 and the parameters for slew 08240049 were afterwards manually updated (spacontool) on the Timeline.

Slew 08240048 was missed from the Timeline

**16/07/2009 (Day of Year 197 , Revolution 824 to 825 )**

Nothing to report

**17/07/2009 (Day of Year 198 , Revolution 825)**

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.

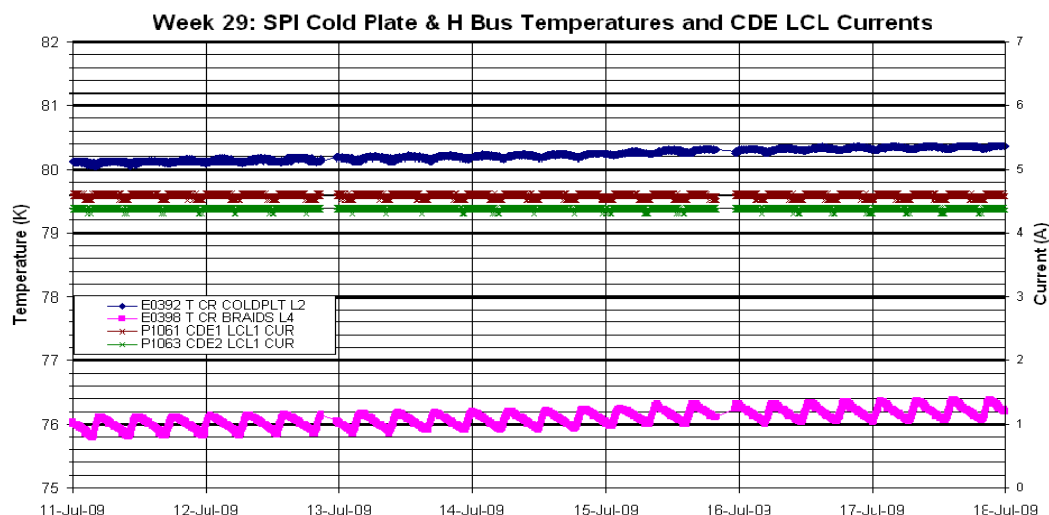
The stroke of all four compressors was set to 39 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.59A
- CDE2 LCL Current = 4.37A

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<sup>5</sup>:

---

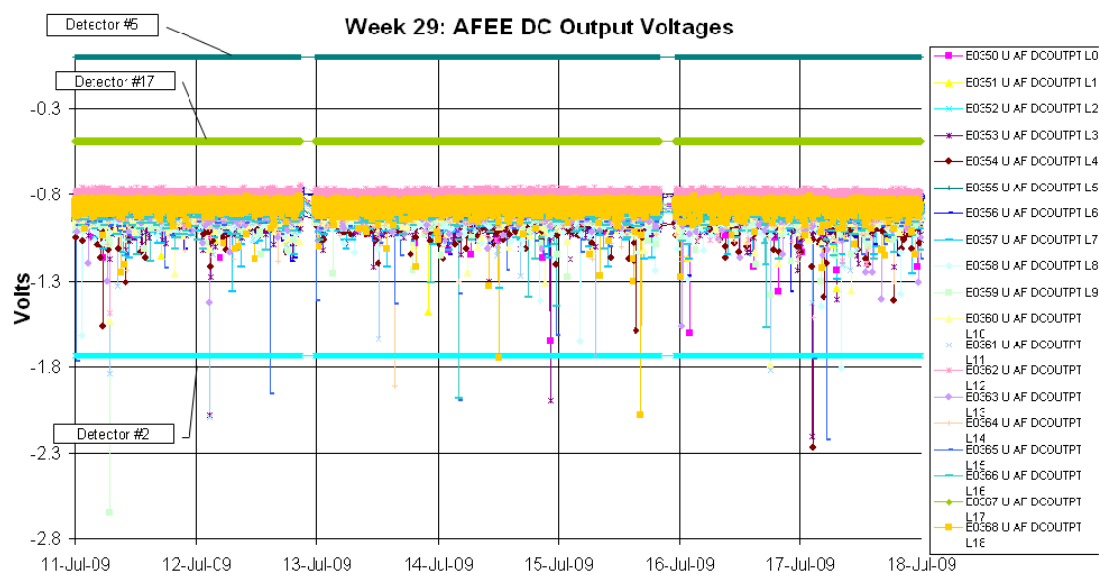
<sup>5</sup> Data sampled every 8<sup>th</sup> packet (64sec)



**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).

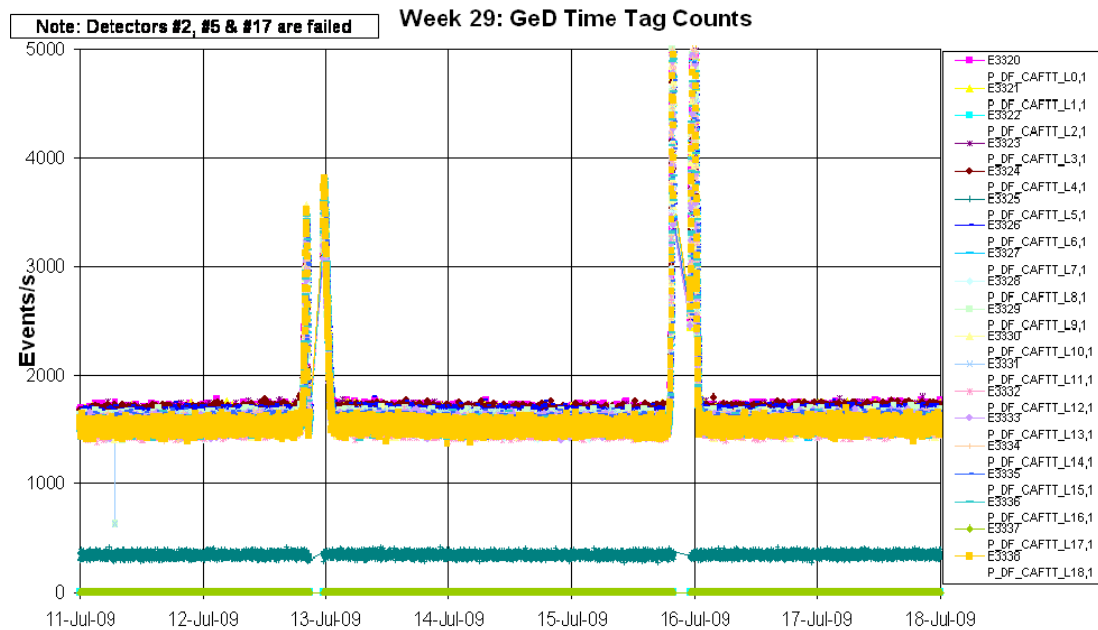
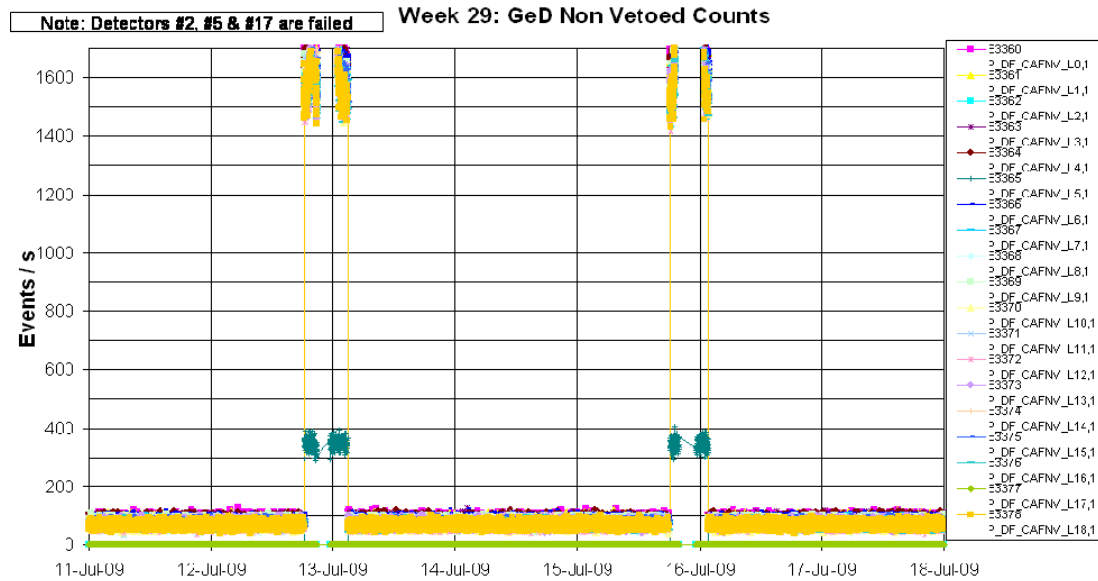
**ACS:** The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT\_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT\_SC-61). A plot of the ACS counts is given in Section 3.2.6.

**AFEE:** The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period<sup>6</sup>. 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.

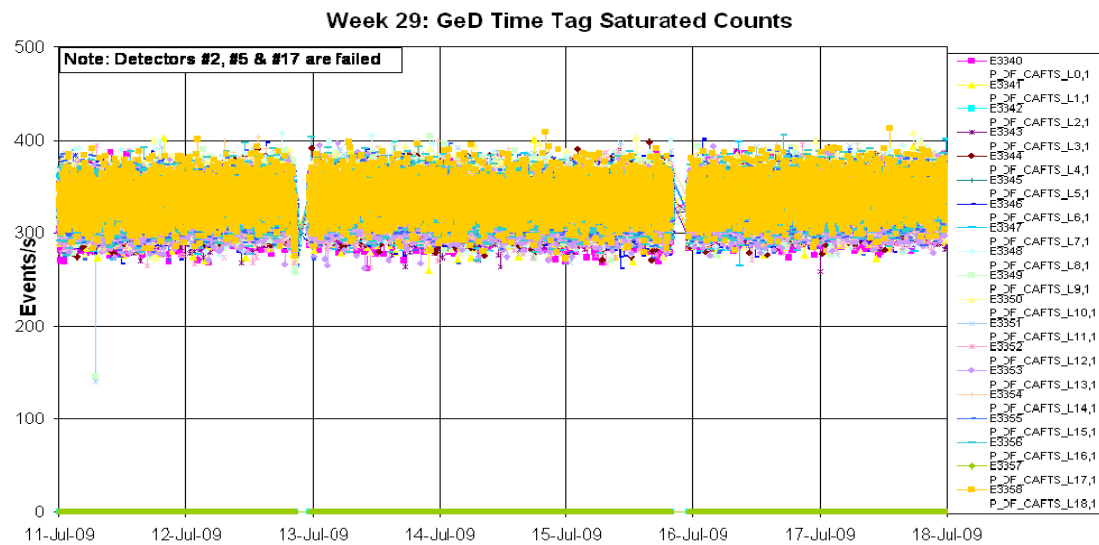


<sup>6</sup> Data sampled every 8<sup>th</sup> packet (64sec)

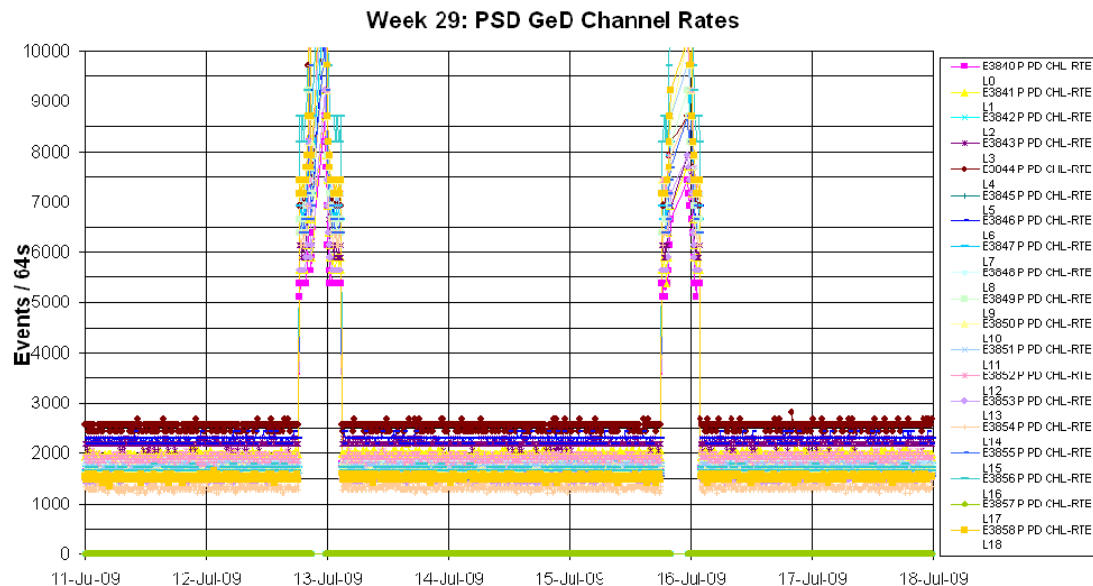
**DFEE:** The health of the unit is nominal. The following plots show the Non Vetoed, Time Tag and Time Tag Saturated Event count rates during the reporting period<sup>7</sup>.



<sup>7</sup> Data sampled every 8<sup>th</sup> packet (64sec)



**PSD:** The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period<sup>8</sup>:



### Event Log:

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

- On 2009.196 at 06.42.50Z OEM APID 1024 ID 243 EXCEPTION SPI1 SPECTRA BUILDING NOT COMPLETED was received with parameter E9780 (DETECTOR ID) = 15. As this was a single occurrence, no action was taken.

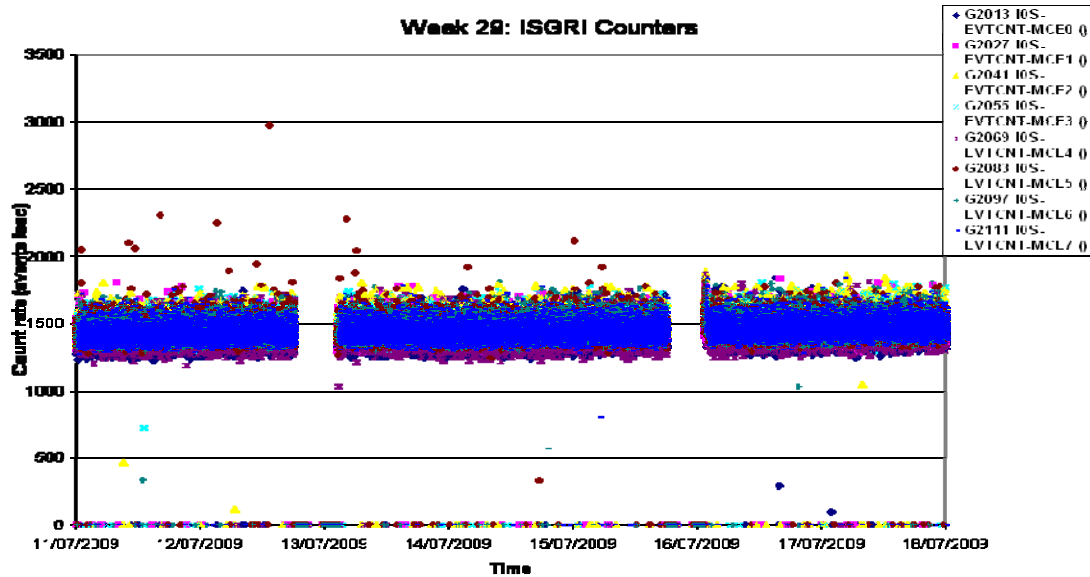
<sup>8</sup> Data sampled every 8<sup>th</sup> packet (64sec)

### 8.2.3 IBIS Operations

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

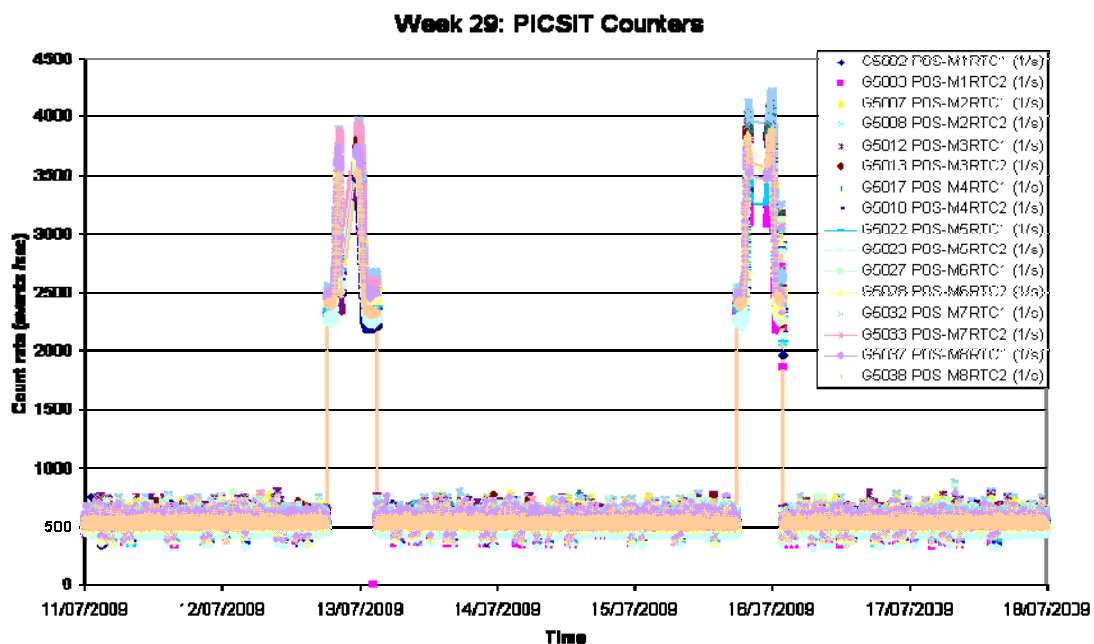
#### ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week<sup>9</sup>:



#### 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<sup>10</sup> :

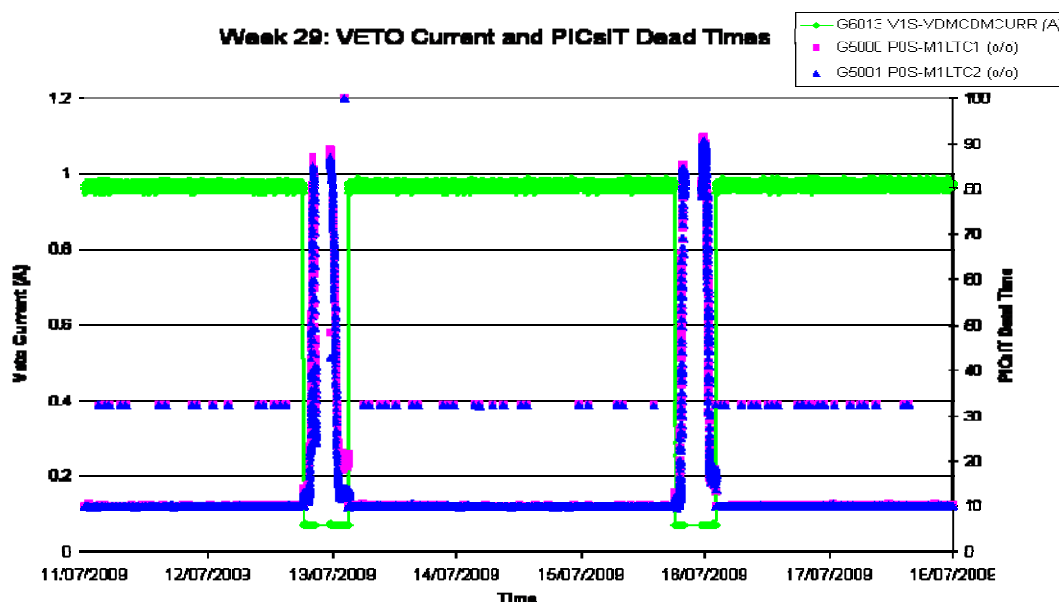


<sup>9</sup> Data sampled every 4<sup>th</sup> packet (32sec)

<sup>10</sup> Data sampled every 4<sup>th</sup> 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<sup>11</sup> :



## 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.

### 2009-07-11 (DOY 192, Rev 823) to 2009-07-12 (DOY 193, Rev 823-824)

IBIS operations executed nominally.

### 2009-07-13 (DOY 194, Rev 824)

TM parameter G2070 went OOL a few times during the day, indicating an overflow of the noisy pixel address buffer in MCE5. As in each case it shortly returned within limits of its own accord, no action was taken.

### 2009-07-14 (DOY 195, Rev 824)

At 17:32Z, following a ground station handover, TM parameter X7500 went OOL, indicating a problem with the histogram process. The following recovery procedure

<sup>11</sup> Data sampled every 4<sup>th</sup> packet (32sec)

was then executed to force the histogram accumulation and download process to resume:

- 18:22:22Z FCP\_IBIS1\_0312
  - 18:24:12Z TC G0129 uplinked to return IBIS to Science Standard mode.
- IBIS operations continued nominally.

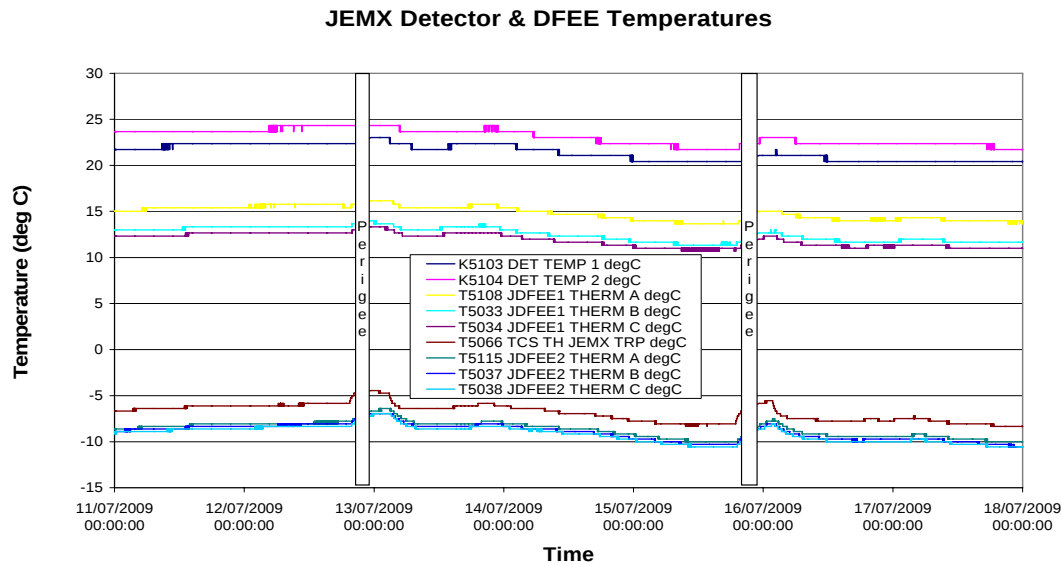
## 2009-07-15 (DOY 196, Rev 824-825) to 2009-07-17 (DOY 198, Rev 825)

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<sup>12</sup>.



#### JEM-X Daily Report

##### 2009-07-11 (DoY 192 Rev 823)

At the indicated times, the following OEMs were received:

|                             |                       |       |          |       |           |
|-----------------------------|-----------------------|-------|----------|-------|-----------|
| 2009.192.12.22.12.804       | 2009.192.12.22.20.633 | 1536  | RealTime | 5     | EXCEPTION |
| JEM-X1 EXC IACS INTERF EXID |                       | 0     | 0        | 65535 | PR N      |
| 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  |          |       |           |
| 2009.192.12.22.12.804       | 2009.192.12.22.20.699 | 1536  | RealTime | 6     | EXCEPTION |
| JEM-X1 EXC IACS INTERF CULP |                       | 0     | 0        | 65535 | PR N      |
| E                           |                       |       |          |       |           |
| FIX6                        |                       | 0     |          |       |           |
| K9079                       | MESS CLASS            | 1     |          |       |           |

<sup>12</sup> Data sampled (1 frame in 8)

Doc. Title : INTEGRAL Mission Report #356  
Doc. Ref. : INT-MOC-SYS-RP-1001-OPS-OAI  
Date : 20/07/09

Issue : 1  
Rev. : 0  
Page : 20

|       |                 |       |
|-------|-----------------|-------|
| 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.

#### **2009-07-12 (DoY 193 Rev 823) to 2009-07-17 (DoY 198 Rev 825)**

JEM-X 1 operations executed nominally.

#### **8.2.5 OMC Operations**

#### **2009-07-11 (DoY 192, Rev 823) to 2009-07-14 (DoY 195, Rev 824)**

Nothing to report.

#### **2009-07-15 (DoY 196, Rev 824)**

At 03:25, an AOCS guide star problem prevented the uplinking of a command. This forced a suspension of the Timeline. A recovery was performed and the Timeline rejoined at 03:52:01. The impact was the loss of pointing 08240048.

#### **2009-07-16 (DoY 197, Rev 825) to 2009-07-17 (DoY 198, Rev 825)**

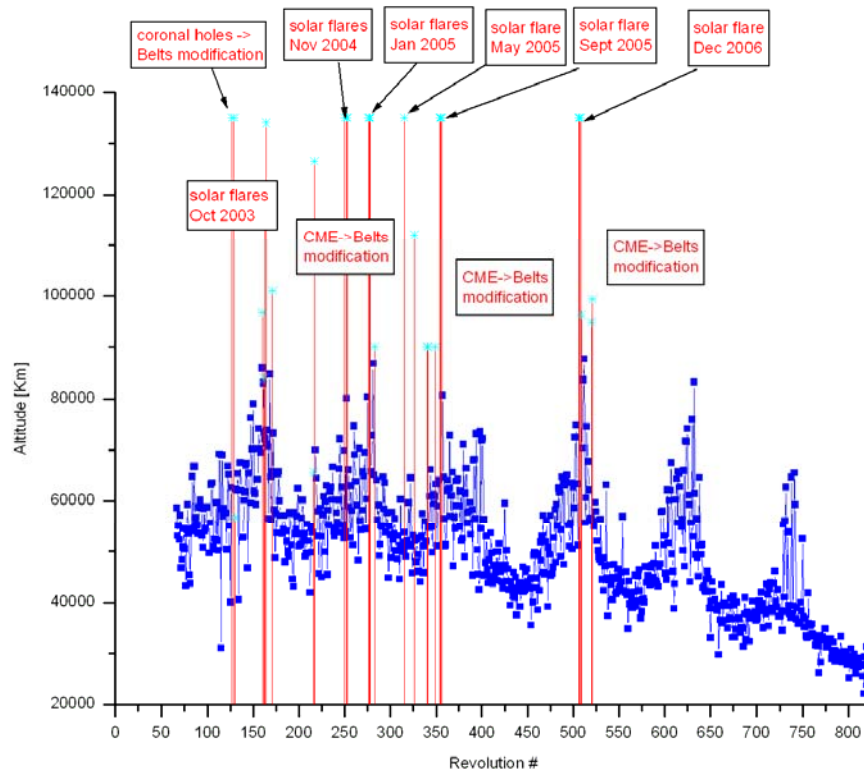
Nothing to report.

On DoY 193 at 18:17:20 and DoY 196 at 18:03:28 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<br>Observed<br>Entry/Exit | Observed<br>Entry/Exit<br>Altitude<br>[Km] | Electron CUT-OFF<br>Predicted<br>Entry/Exit | Predicted<br>Entry/Exit<br>Altitude<br>[Km] |
|-----|-------------------------------------|--------------------------------------------|--------------------------------------------|---------------------------------------------|---------------------------------------------|
| 823 | RAD_ENTR R 2009-07-<br>12T18:17:12Z | 12/07/2009<br>19:27:19                     | 30810.9                                    | 12-Jul-2009<br>19:27:52                     | 30573.76                                    |
| 824 | RAD_EXIT R 2009-07-<br>13T02:48:23Z | 13/07/2009<br>01:15:59                     | >>32749.1                                  | 13-Jul-2009<br>01:37:52                     | 46545.07                                    |
| 824 | RAD_ENTR R 2009-07-<br>15T18:03:20Z | 15/07/2009<br>19:11:43                     | 31849.0                                    | 15-Jul-2009<br>19:18:34                     | 30179.66                                    |
| 825 | RAD_EXIT R 2009-07-<br>16T01:46:33Z | 16/07/2009<br>01:03:51                     | >>32754.1                                  | 16-Jul-2009<br>01:28:34                     | 46932.91                                    |

Reference

High radiation

Very small error vs reference (less than 10 minutes)

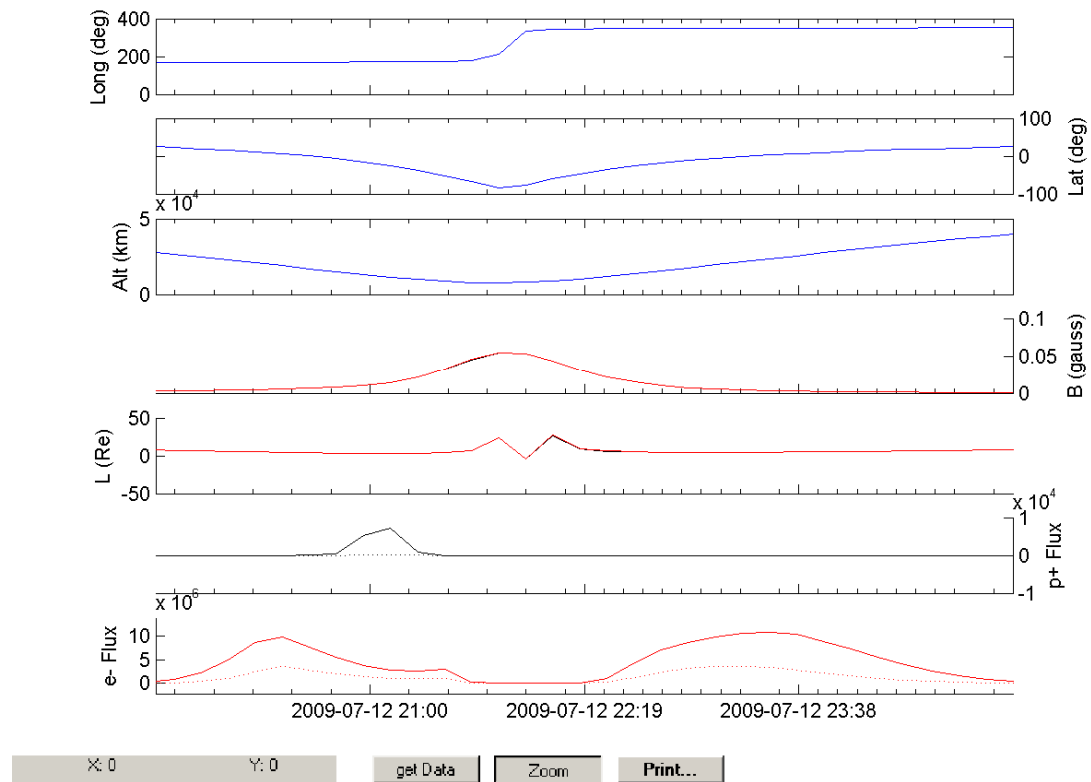
Small error vs reference (between 10 and 30 minutes)

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 823



Rev 824

