

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OAI
No. 366
Week 39
28.09.09
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 19.09.09 until 25.09.09 (both dates inclusive) and covers the revolutions 846, 847 and 848.

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 Target of Opportunity a raster dither of IGR J17511-3057 (RA 17:51:14.64, -30:57:14.4), a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00, -28:56:00.0), a custom pointing of the Galactic disk, (RA 19:04:22.00, +06:17:13.0) and a raster dither of the Galactic Centre (RA 17:45:40.03, -29:00:28.1).

Note: Some further information concerning the activities is provided in the Appendix.

3 Satellite Status

3.1 Platform

The performance of the platform was good. No new unexpected behaviour / malfunction was identified.

3.1.1 AOCS

The AOCS operations were performed from the timeline during this period.

No slews were missed from the timeline.

The fuel consumption over the period between 19/09/2009 and 25/09/2009 was 0.0894 Kg. The remaining propellant is in the order of 132.3516 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

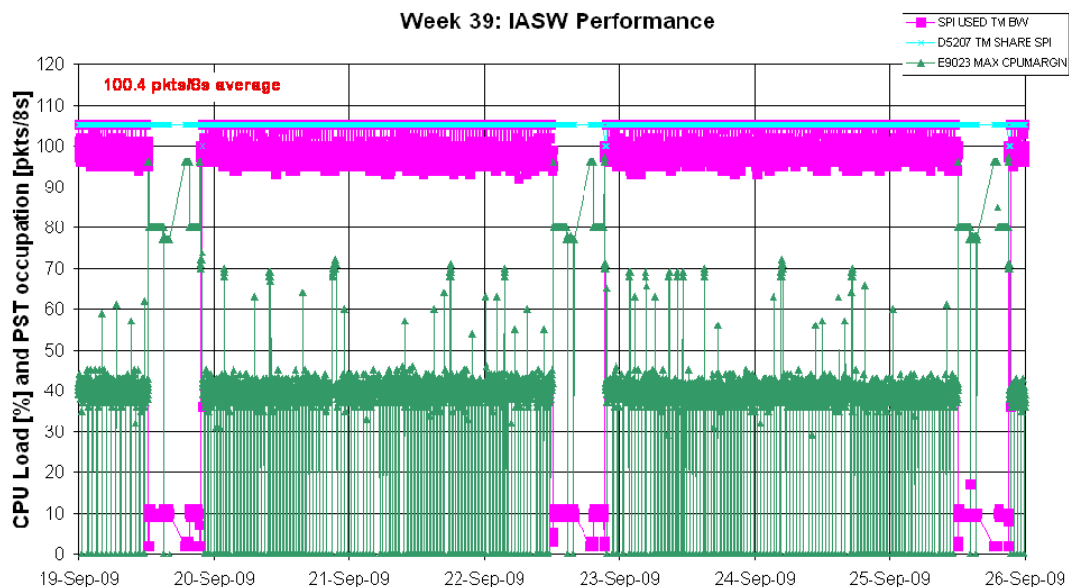
Following the 13th SPI annealing, which ended on 11/05/2009, the overall status of the gamma-ray spectrometer is nominal, except for detector #2 (failed since 06/12/2003); detector #17 (failed since 17/07/2004) and detector #5 (failed since 19/02/2009).

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

Eclipse operations for SPI continued nominally during the reporting period.

SPI was operated in photon-by-photon mode with spectra TM enabled during science observations. The assigned TM bandwidth in the science observation windows was 105 packets/cycle the average telemetry occupation was 100.4 packets/cycle.

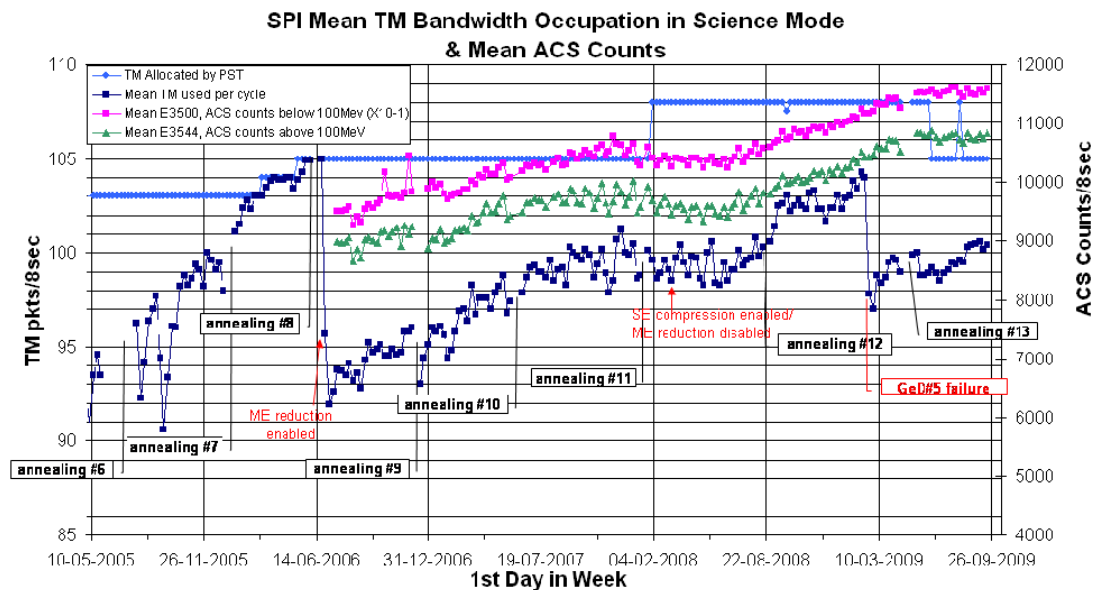
The following plot shows the TM bandwidth allocation, occupation and DPE CPU load during the reporting period¹:



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

¹ Data sampled every 8th packet (64sec)

(since July 2006). As can be seen, there is a strong correlation between the evolution of the background as measured by the ACS and the overall TM bandwidth usage.



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

3.2.2 IBIS

The overall status of IBIS is nominal.

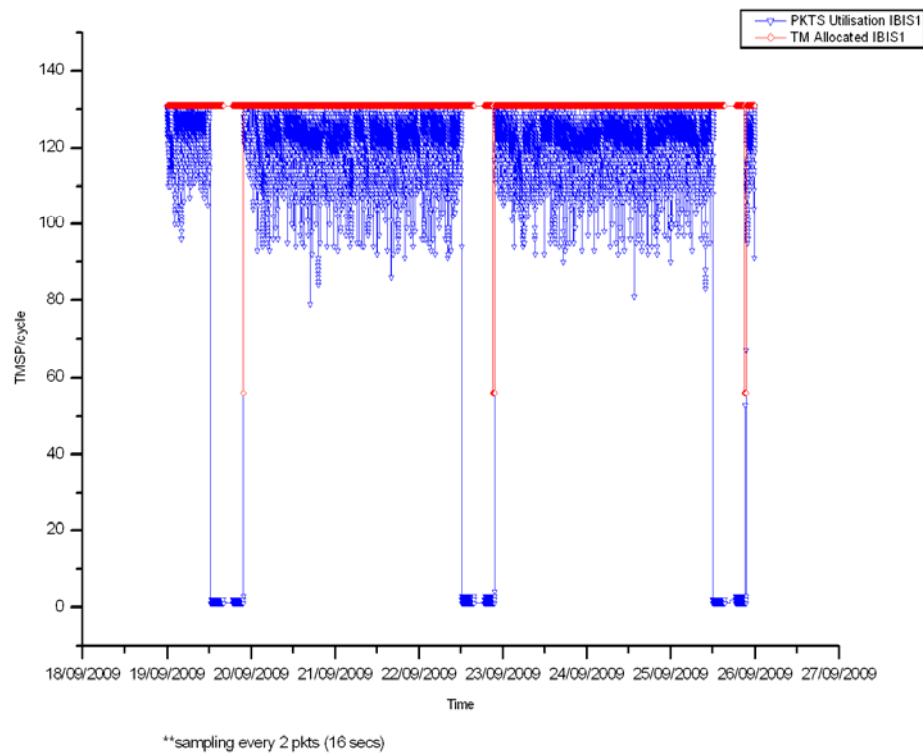
Eclipse operations for IBIS are progressing nominally.

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

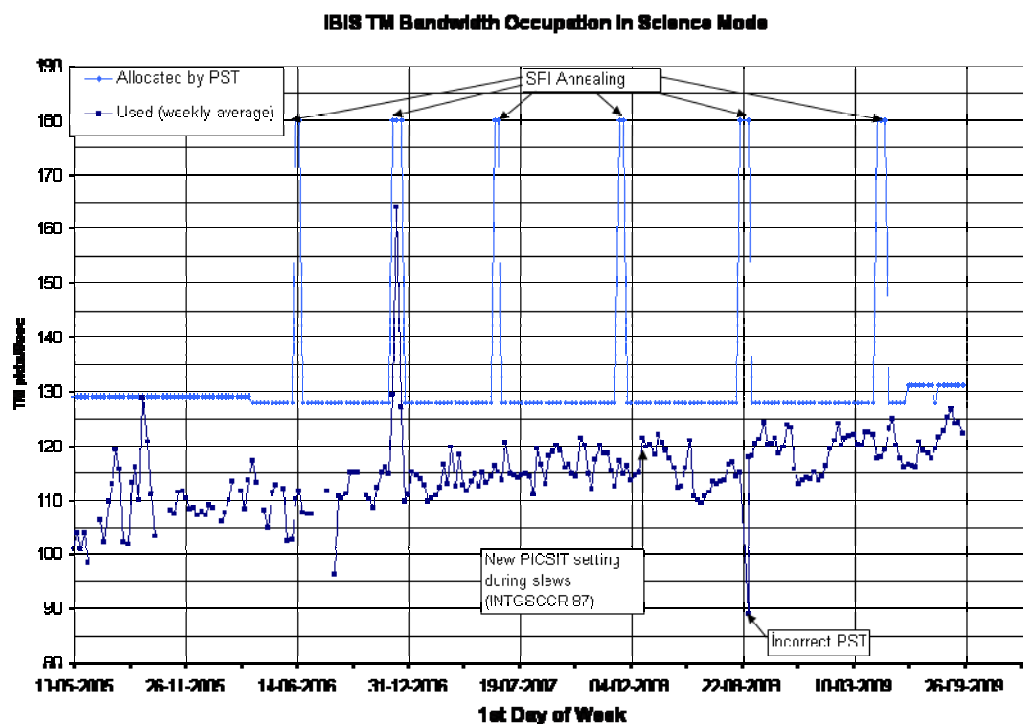
- PST allocation to IBIS above radiation belts: 131 packets/cycle
- IBIS mean bandwidth utilisation in science mode: 122.40 packets/cycle (down 1.95 on previous week)
- Percentage of TM cycles for which full bandwidth was used: 6.2%

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

IBIS - TM Bandwidth Utilisation Rev 846-849



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.

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 212 planned science pointings were executed nominally.

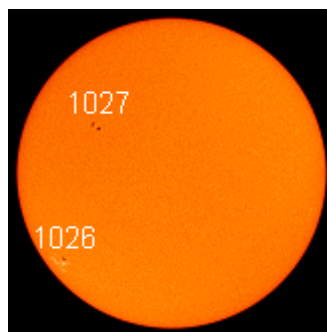
Note: Some more information concerning the OMC operations is provided in the Appendix.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised by low solar activity. The sun began the week blank. On the 21st, sun spot #1026 rotated into view and on the 23rd sun spot #1027 emerged. Both spots remained for the rest of the week. The risk of solar flares was very low.

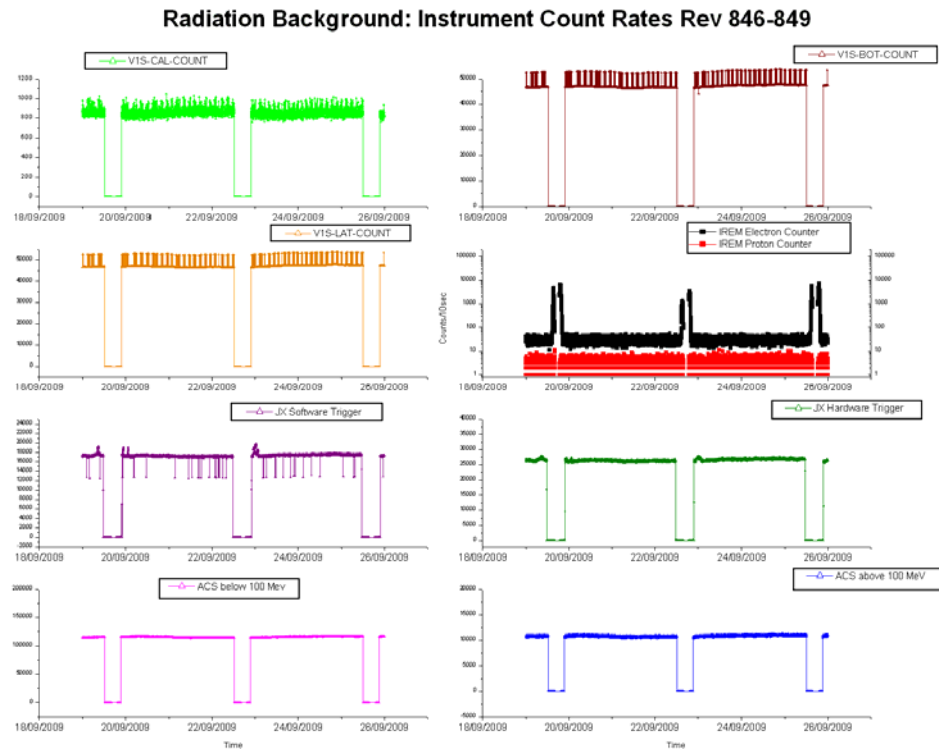


Reference: www.spaceweather.com

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

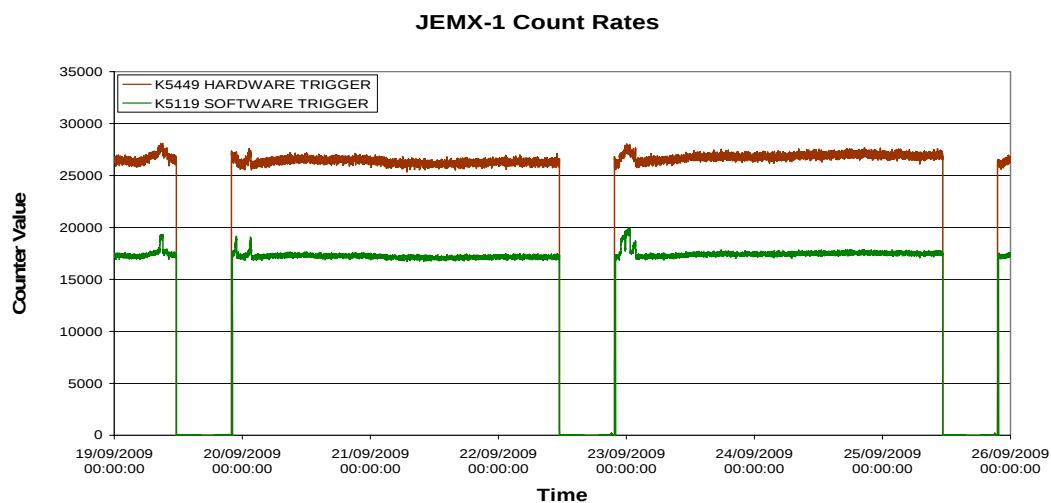
3.2.6 Radiation Background

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 week²:



JEM-X Count Rates

JEM-X count rates over the reporting period are displayed in the following graph³.

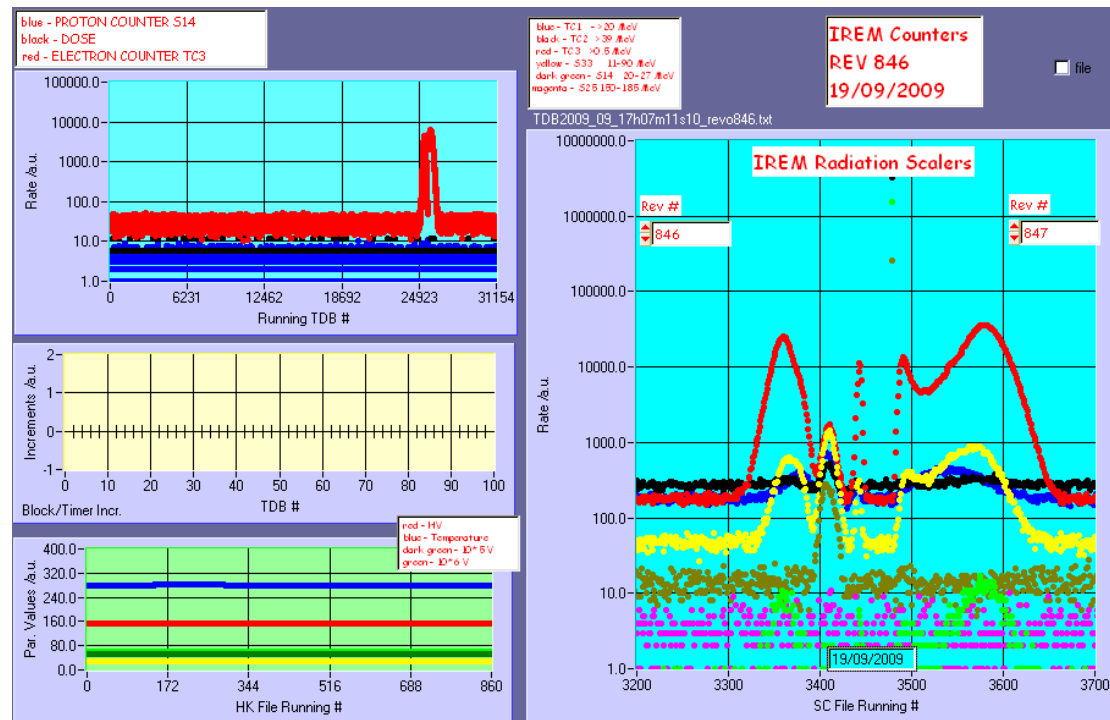


² Data sampled every 6th packet (48sec)

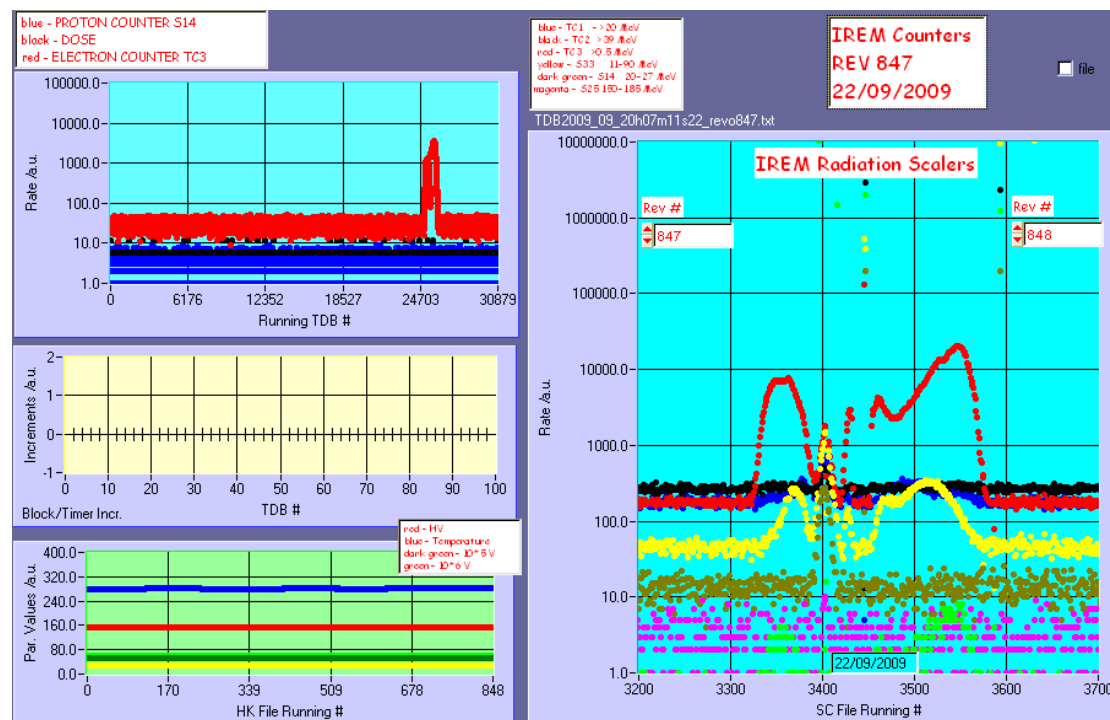
³ Data sampled (1 frame in 4) and smoothed to remove spikes in S/W Trigger due to flushing of buffer after slews.

IREM radiation counters:

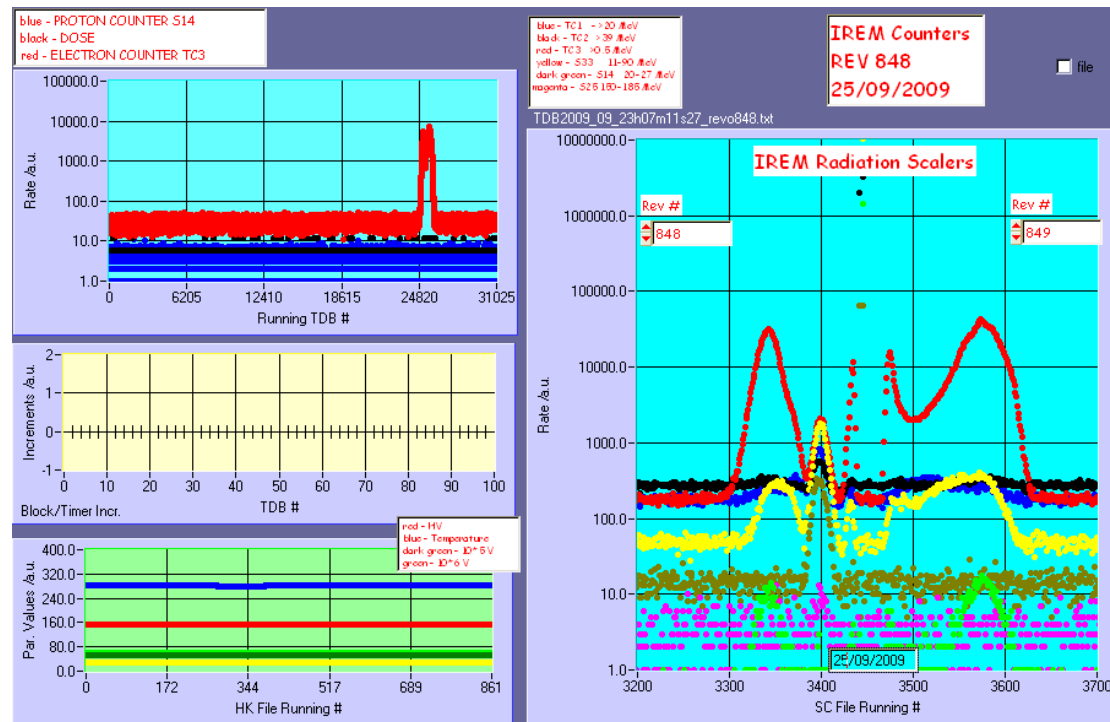
Revolution 846



Revolution 847



Revolution 848



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 two 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 was one occasion of a TM drop VC0 and VC7 from Redu without any impact.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSFs have been received for revolutions 855 and 856.

Observations have been planned for revolutions 852 & 853.

New TSFs have been received for revolutions 849 and 850.

2. Observation status

New ECS files have been received for revolutions 831 to 834.

3. ISOC Science Data Archive

Ingestion of data from ISDC complete up to revolution 832. Raw telemetry transferred without problems and complete up to 20 September. A student project (SAID) for added visibility of archival data has begun.

4. ISOC system

ISOC software version V23.1 was released for testing on 21 September and successfully tested.

5. Problems

No new problems.

5 Special Events

6 Anomalies

The following anomaly occurred this week:

AR id	Date Created	Subject	Segment	Status
INT_SC-266	2009-09-25	Spurious Switch Off of RMU-A LCL	Spacecraft	Pending
INT_SC-268	2009-09-30	JEM-X1 DFEE CRC Anomaly following eclipse on 2009-09-19	Payload	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Detailed Satellite Information

This section contains some detailed information concerning the various subsystems of the satellite and instruments.

8.1.1 AOCS SUMMARY OPERATIONS REPORT, 19/09/2009 – 25/09/2009

The AOCS operations were executed from the Automatic Timeline.

During this period, 113 Open Loop Slews, 119 Closed Loop Slews and 5 Momentum Biases were executed (as reported by ACC OEM).

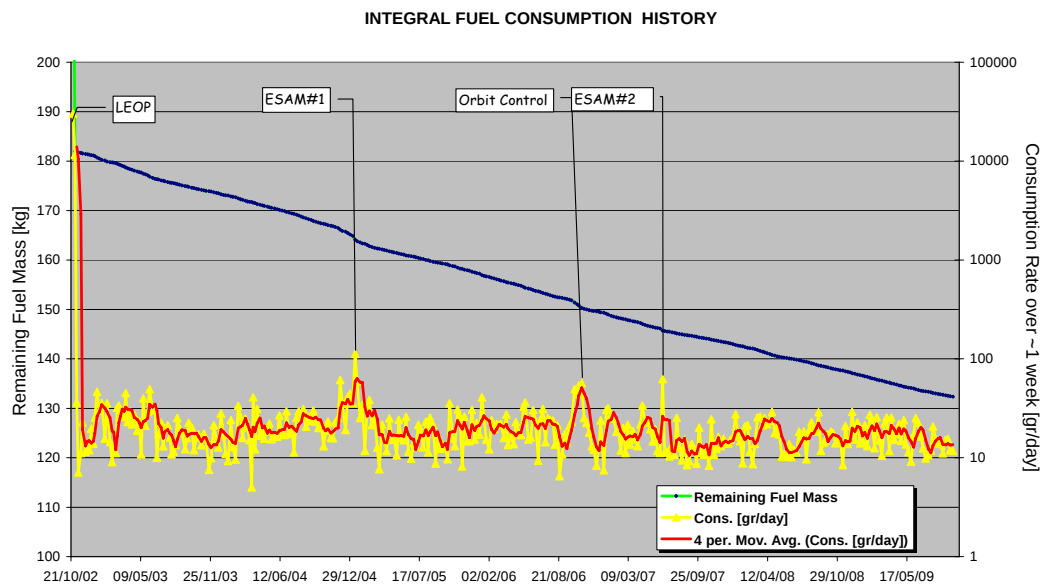
No slews were missed from the timeline.

Orbit Control

No update.

Fuel consumption

The fuel consumption (total, grams per day) over the period between 01/11/2002 and 25/09/2009 is reported in the plot below.

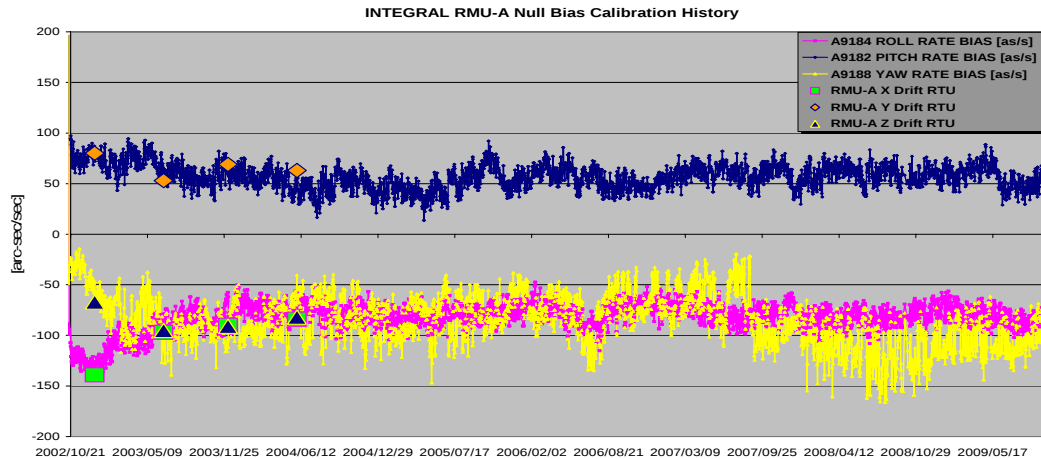


The above plot considers the ESAM fuel consumption spread over period of ~1 week.

The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 25/09/2009 is reported in the plot below.

The evolution of the drift on yaw channel is under constant monitoring but the values are still well within the specs. At moment the current constraints (for drift update generation) on the FDS have been relaxed to cope with the current situation.



Daily events Log:

19/09/2009 (Day of Year 262, Revolution 846 to 847)

Nothing to report

20/09/2009 (Day of Year 263, Revolution 847)

Nothing to report

21/09/2009 (Day of Year 264, Revolution 847)

Nothing to report

22/09/2009 (Day of Year 265, Revolution 847 to 848)

Nothing to report

23/09/2009 (Day of Year 266, Revolution 848)

Nothing to report

24/09/2009 (Day of Year 267, Revolution 848)

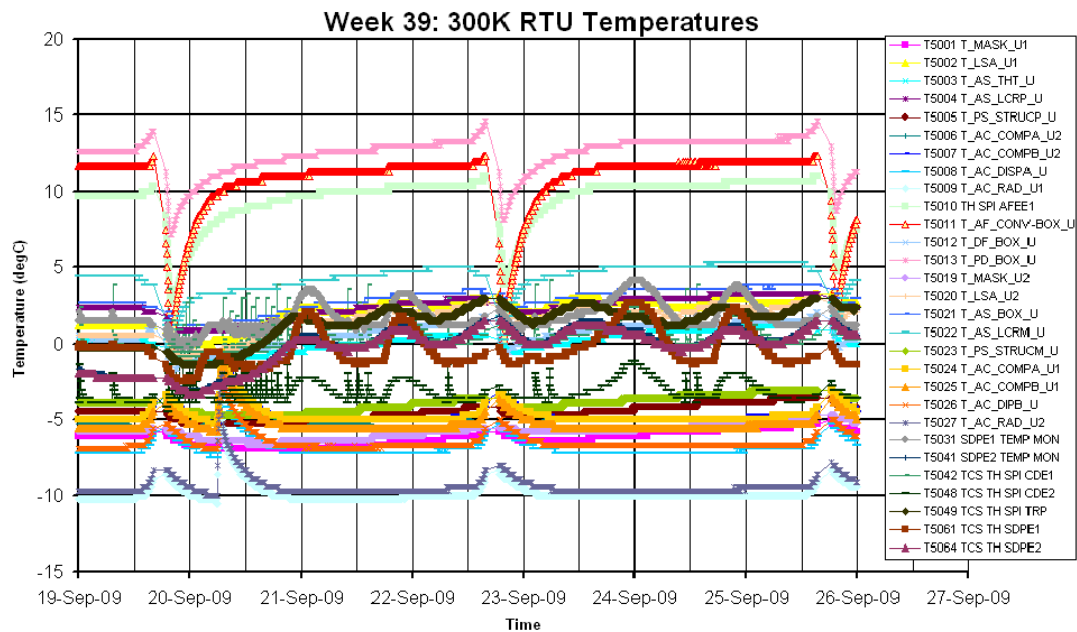
Nothing to report

25/09/2009 (Day of Year 268, Revolution 848 to 849)

Nothing to report

8.1.2 SPI Operations

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



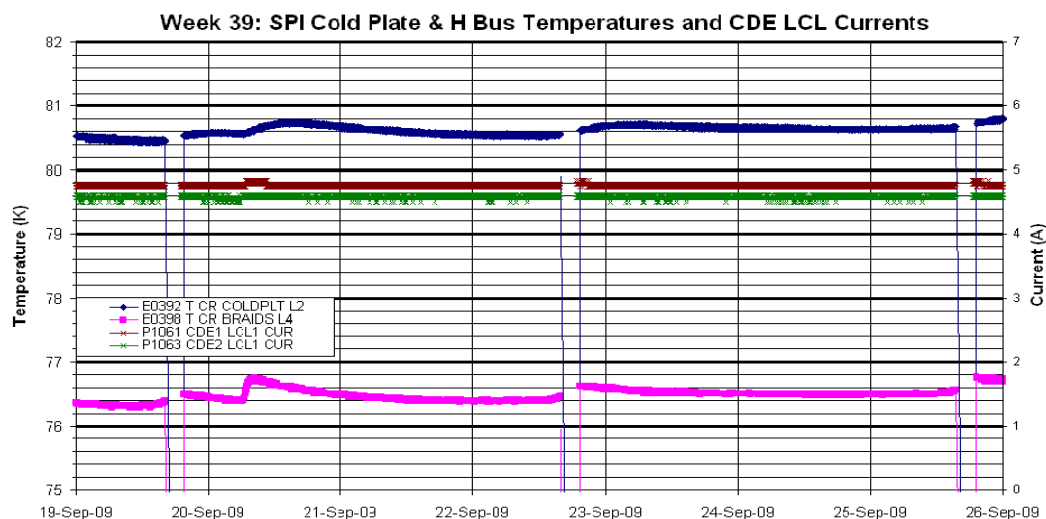
Stirling Compressors and Cryostat: The performance of the compressors is nominal. The cold plate temperature was maintained in the range 80K +/-1K.

The stroke of all four compressors was set to 40 throughout the week and the average CDE LCL currents were as follows:

- CDE1 LCL Current = 4.76A
- CDE2 LCL Current = 4.57A

The following plot shows the evolution of the cold plate and H bus temperature as well as the CDE LCL currents during the reporting period⁴:

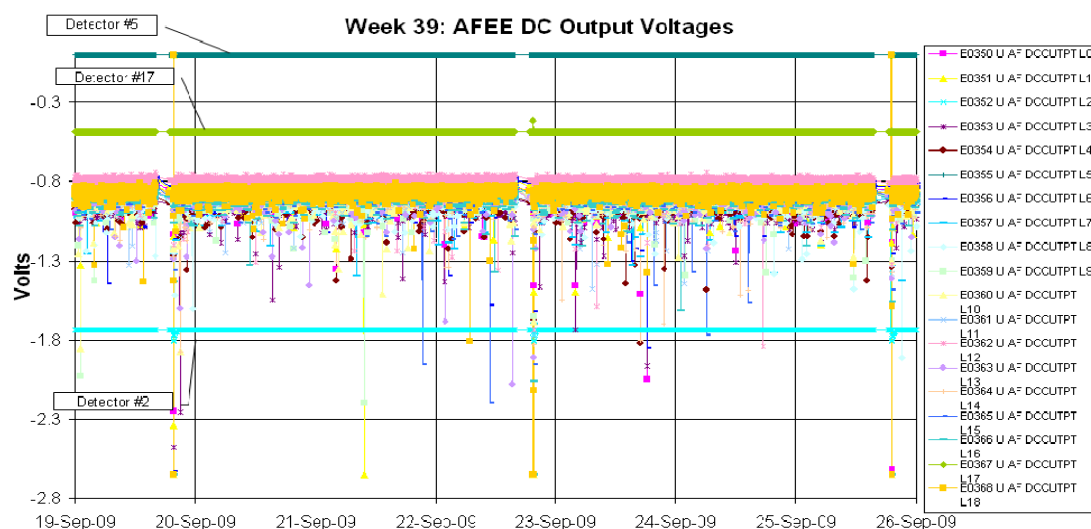
⁴ Data sampled every 8th packet (64sec)



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

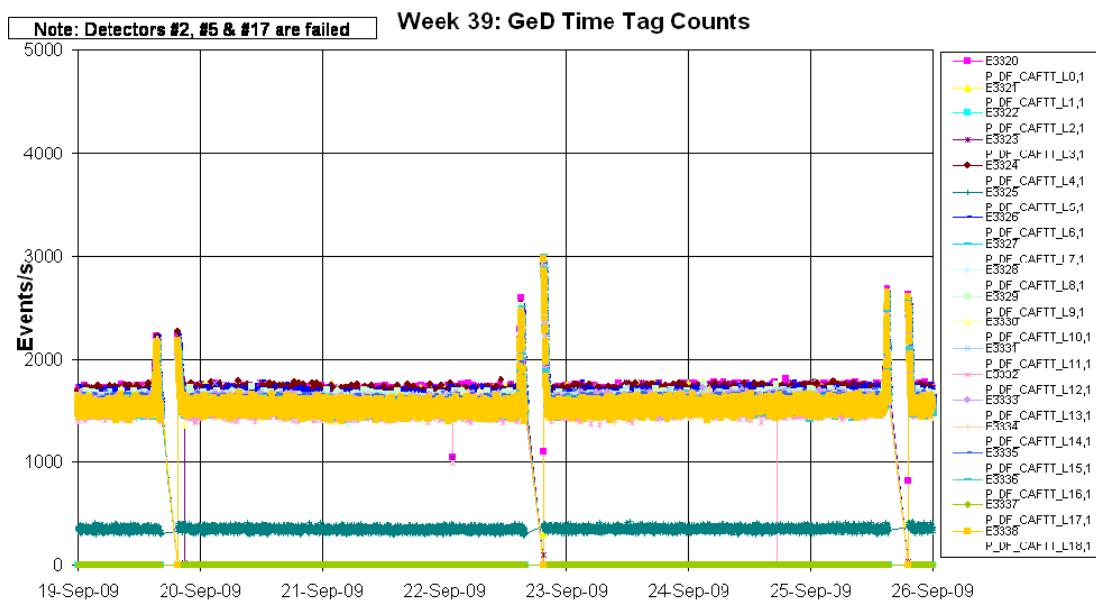
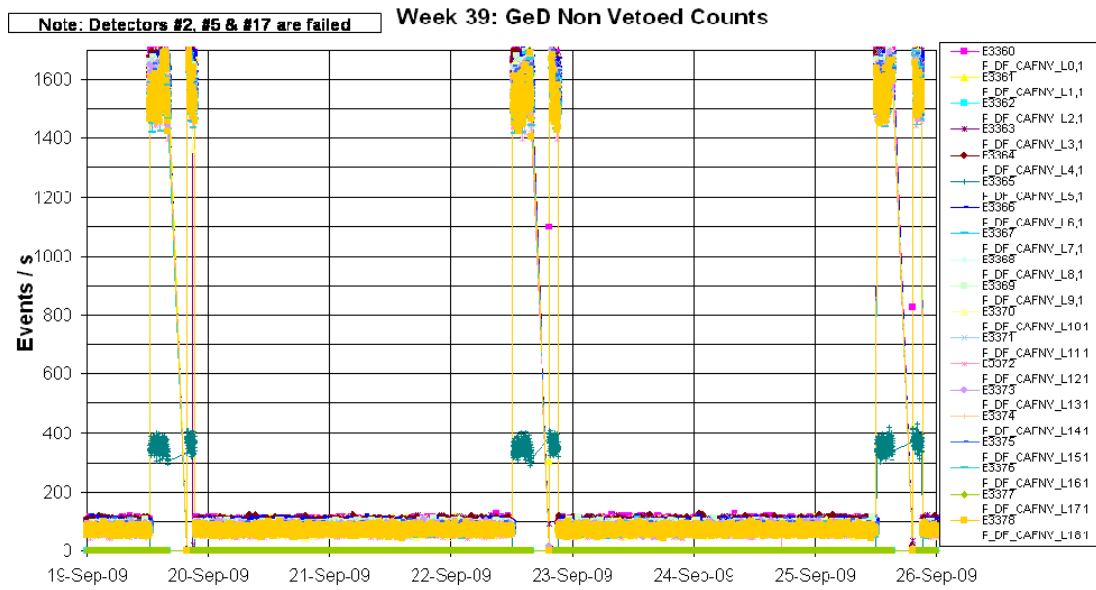
ACS: The performance of the ACS is nominal, except for FEE #81 which remains nominally switched off since the anomaly on 29/10/2006 (INT_SC-162) and FEE #57 which is nominally OFF due to the anomaly on 5/8/2003 (INT_SC-61). A plot of the ACS counts is given in Section 3.2.6.

AFEE: The health of the AFEE is nominal. The following plot shows the dc output voltage of the detector channels during the reporting period⁵. The values are nominal. Detector #2 is failed since 06/12/2003; detector #17 is failed since 17/07/2004 and detector #5 is failed since 19/02/2009. The HV of the failed detectors are nominally set to 0.5kV.

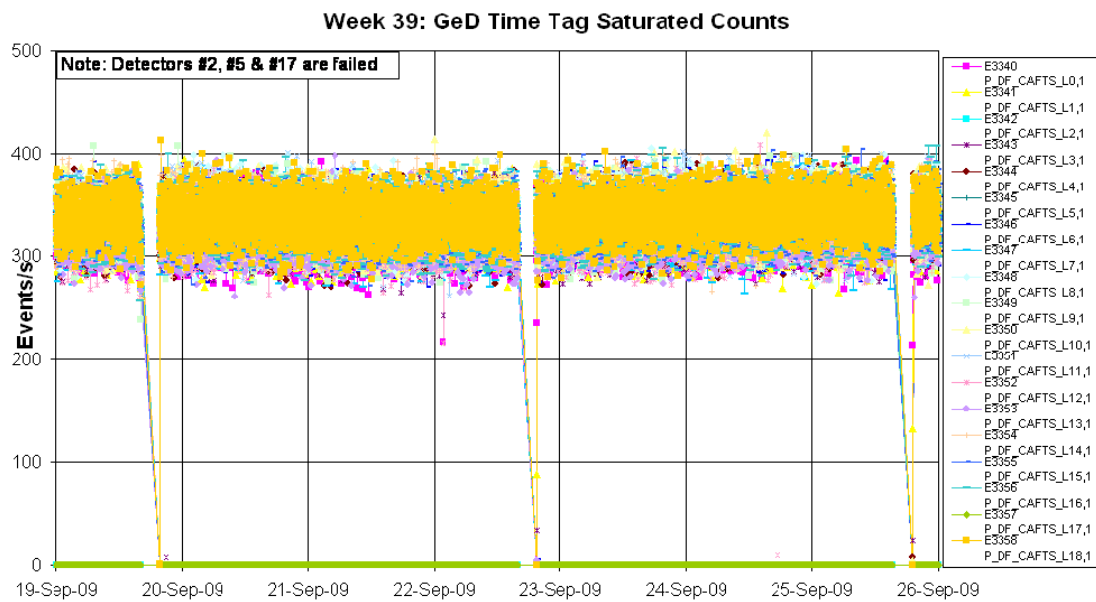


⁵ Data sampled every 8th packet (64sec)

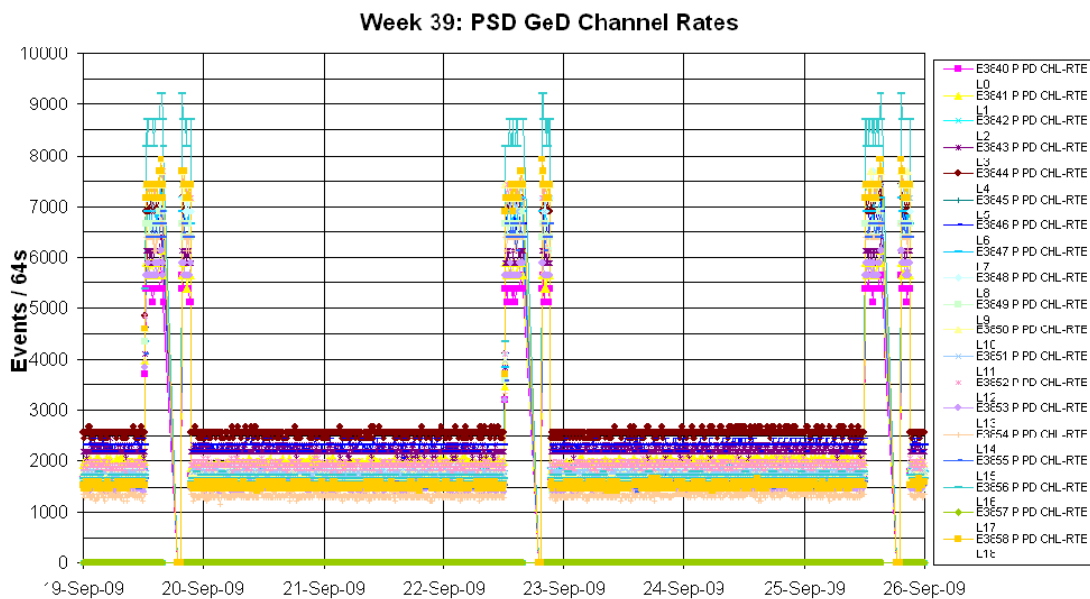
DFEE: The health of the unit is nominal. The following plots show the Non Vetoeed, Time Tag and Time Tag Saturated Event count rates during the reporting period⁶.



⁶ Data sampled every 8th packet (64sec)



PSD: The overall health of the unit is nominal. The following plot shows the PSD channel rates over the reporting period⁷:



Event Log:

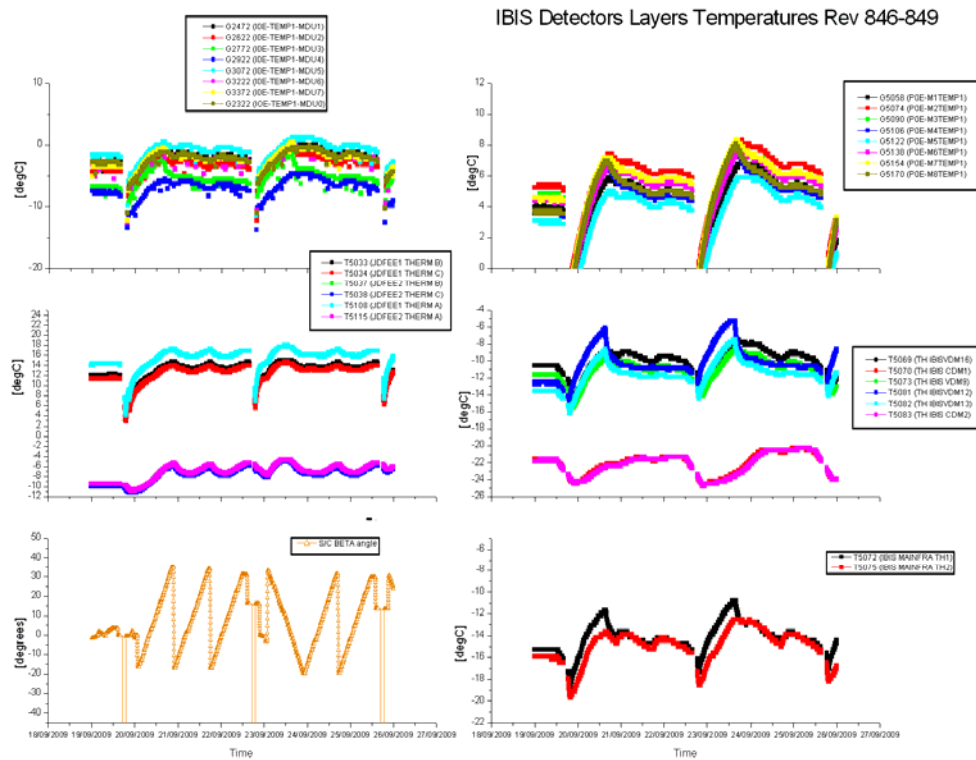
The following non-nominal events occurred with SPI over the reporting period:

- On 2009-09-22 at 01:10:55Z TM parameter E2253 (ACS FEE analogue status 5 V #3) went OOL (value = NO EXIST VAL). As it returned within limits when the next packet was received at 01:21:35Z, no action was taken.

⁷ Data sampled every 8th packet (64sec)

8.1.3 IBIS Operations

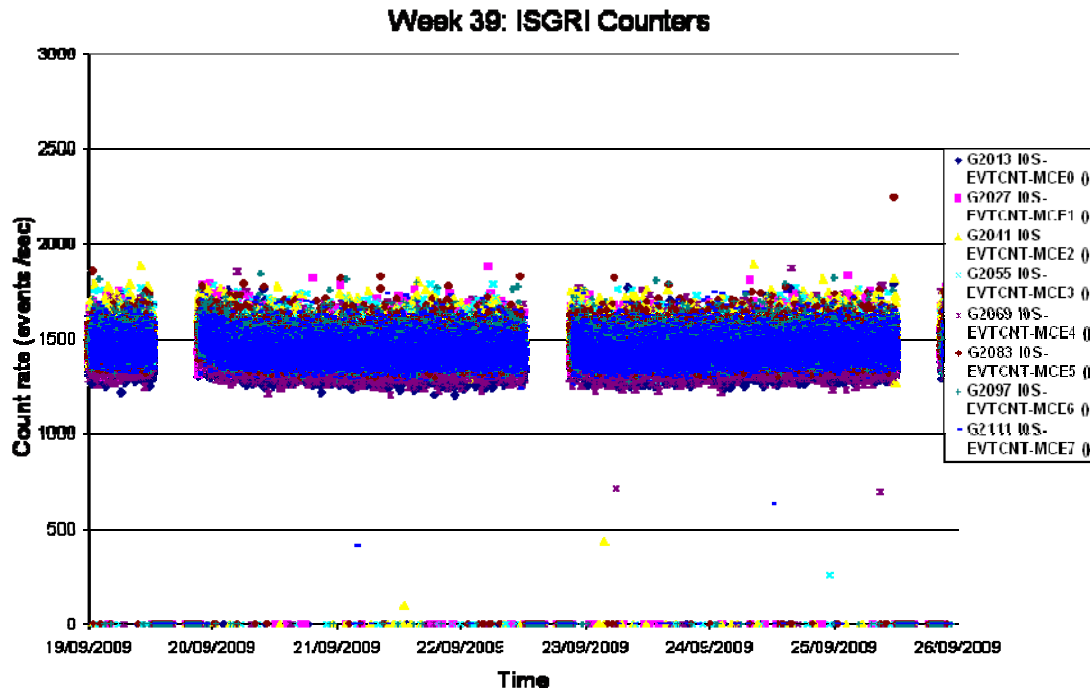
Unit Temperatures: All the equipment temperatures were inside the operational limits throughout the week. The following plot shows selected IBIS temperatures, along with those of the JEM-X DFE and the S/C beta angle for comparison. The temperature recovery of the units after eclipse was nominal.



**sampling every 8 pkts (64 secs)

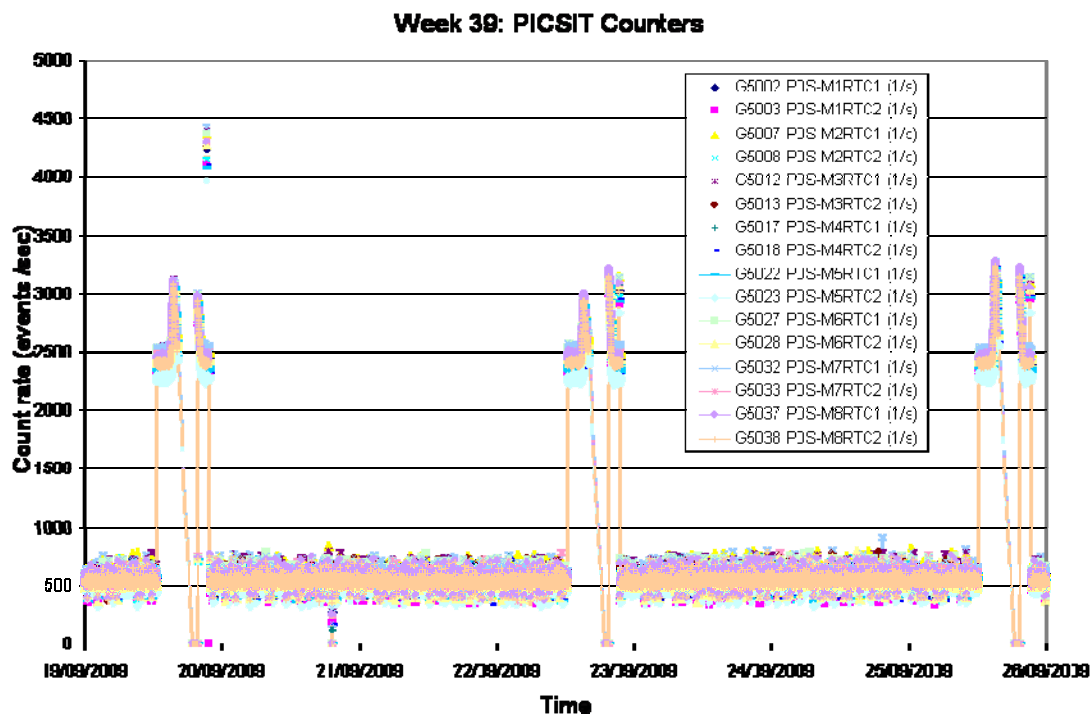
ISGRI

The health and performance of ISGRI was nominal during the reporting period. The following plot shows the ISGRI MCE counters during the week⁸:



PICsIT

The health and performance of PICsIT was nominal during the reporting period. The following plot shows the PICsIT semi-module counters during the week⁹:

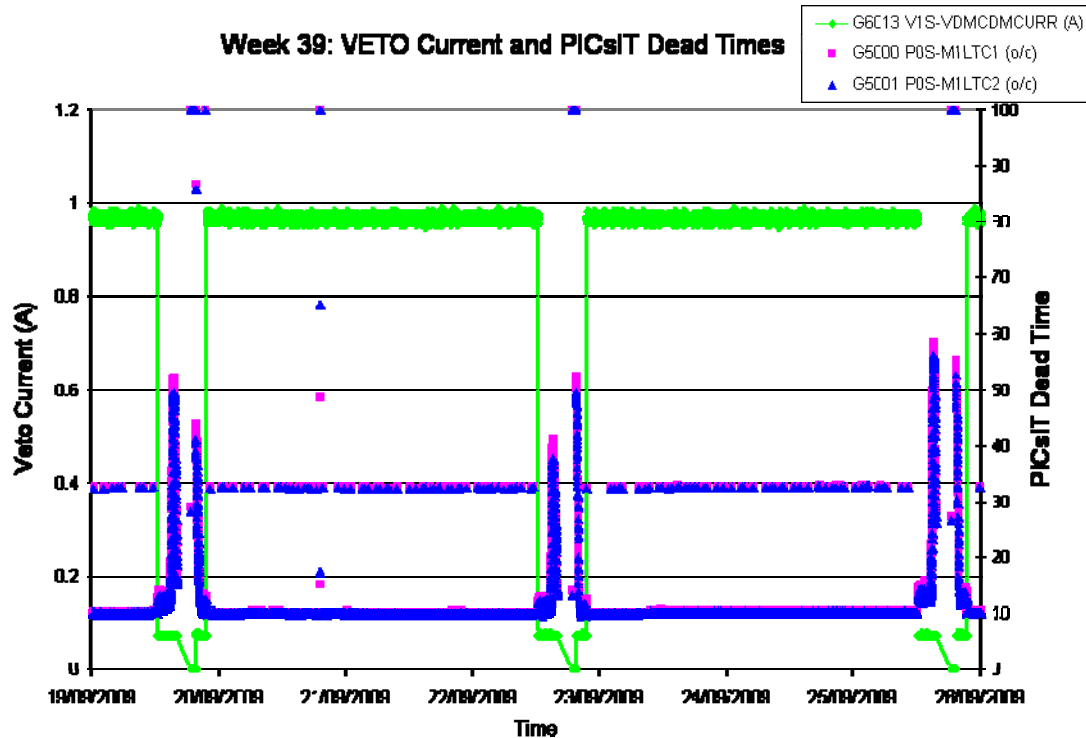


⁸ Data sampled every 4th packet (32sec)

⁹ Data sampled every 4th packet (32sec)

VETO

The health and performance of VETO was nominal during the reporting period. The following plot shows the VETO current and PICsIT dead-times during the week¹⁰:



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.

2009-09-19 (DOY 262, Rev. 846-847)

IBIS operations executed nominally.

2009-09-20 (DOY 263, Rev. 847)

Starting at 19:14:22Z parameters of the TM parameter families G5068 and G5072 failed status consistency check (value = TRUE). These are the PDM semi-module FIFO error flags. At 19:14:49Z the TM parameter families G5002 and G5003 for the PDM semi-module counters went OOL Low. As these parameters had all returned within limits by 19:15:37Z, no action was taken.

2009-09-21 (DOY 264, Rev. 847) to 2009-09-23 (DOY 266, Rev. 848)

IBIS operations executed nominally.

¹⁰ Data sampled every 4th packet (32sec)

2009-09-24 (DOY 267, Rev. 848)

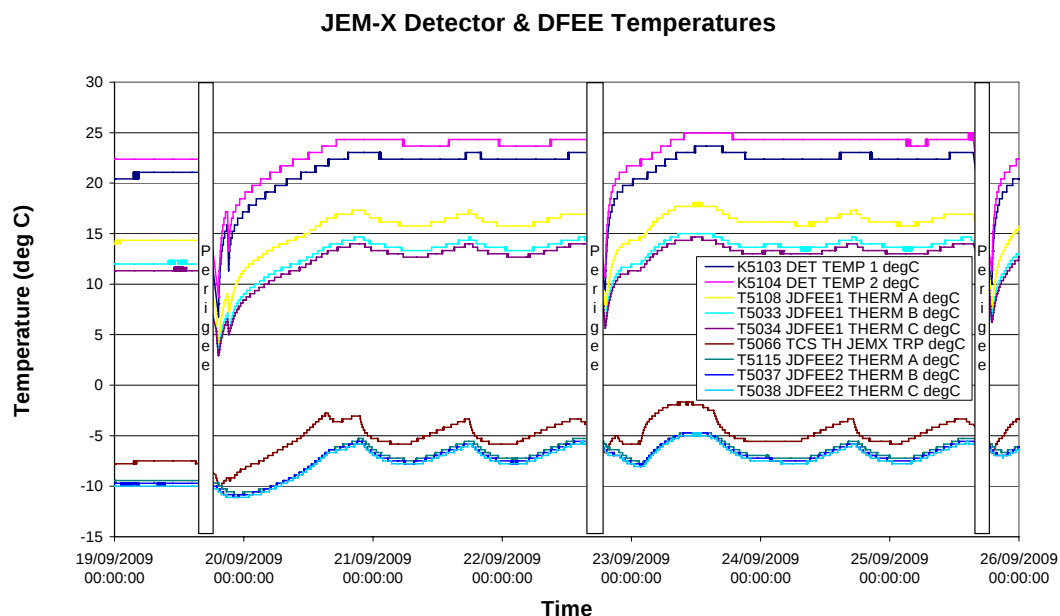
TM parameter G2070 toggled OOL between 16:08:57Z and 16:13:13Z, indicating an overflow of the noisy pixel address buffer in MCE5. As it returned within limits of its own accord, no action was taken.

2009-09-25 (DOY 268, Rev. 848-849)

IBIS operations executed nominally.

8.1.4 JEM-X Operations

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph¹¹.



JEM-X Daily Report

2009-09-19 (DoY 262 Rev 846-847)

At 19:17:11, during the post-eclipse reconfiguration of JEM-X1, a DFEE anomaly occurred:

The symptoms were as follows:

1) The following OEMs were received after the JEM-X1 DFEE was switched on by the ED KECLXT01 (executed by time-tag at 2009-09-19T19:16:30Z):

```
2009.262.19.17.11.156 2009.262.19.17.15.473 1536 RealTime 191 EVENT JEM-X1 PROB
DFEE 11 0 0 65535 PR N E E
FIX6 11
K9079 MESS CLASS 0
K9080 MESS ID 191
FIX16 8
FIX16 0
```

¹¹ Data sampled (1 frame in 8)

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>> Indicating that the operation “Load DFEE context” was unsuccessful due to CRC failure of the area B000 (hex) to CFFF (hex).

```
2009.262.19.17.11.156 2009.262.19.17.15.499 1536 RealTime 234 EVENT JEM-X1 AUTO
EVENT 4 0 0 65535 PR N E E
FIX6 4
K9079 MESS CLASS 0
K9080 MESS ID 234
K5419 ACTUAL LEVEL ECLIPSE
K5420 TARGET LEVEL RAD.
```

>>> Indicating failure of the automatic recovery from shutdown level ECLIPSE to shutdown level RAD. BELTS

2) Following the execution of KECLXT01 ED, the JEM-X1 DFEE state (TM parameter K5022) remained MEMORY, instead of SAFE, and the Active Shutdown Level (TM parameter K5381) remained ECLIPSE instead of RAD. BELTS.

3) The DFEE CPU speed, TM parameter K5583 CPU MODE, remained at a value of 8 MHz WAIT (as at start-up) rather than the nominal value of 16MHz.

In response to this, the following operations were performed:

- 1) To recover JEM-X1, a DFEE power cycle was then performed according to CRP_JEM1_5010 JEMX1 DFEE POWER CYCLE

From 21:10:39 to 21:11:00, TM parameter KD5380D indicated a false status. No action was taken, and there was no impact.

During the power cycling activities, there were a string of minor out-of-limits, which are normal during this activity.

At 21:18Z JEMX re-enabled in T/L. (one minute before the KEACAL01 ED!!)

The above recovery proceeded nominally and JEM-X1 operations then continued from the Timeline.

2009-09-20 (DoY 263 Rev 847) to 2009-09-21 (DoY 264 Rev 847)

JEM-X 1 operations executed nominally.

2009-09-22 (DoY 265 Rev 847-848)

From 19:07:24 to 19:07:48, TM parameter KD5380D indicated a false status. No action was taken, and there was no impact.

2009-09-23 (DoY 266 Rev 848) to 2009-09-24 (DoY 267 Rev 848)

JEM-X 1 operations executed nominally.

2009-09-25 (DoY 268 Rev 848-849)

From 18:56:44 to 18:57:08, TM parameter KD5380D indicated a false status. No action was taken, and there was no impact.

8.1.5 OMC Operations

2009-09-19 (DoY 262, Rev 846) to 2009-09-25 (DoY 268, Rev 849)

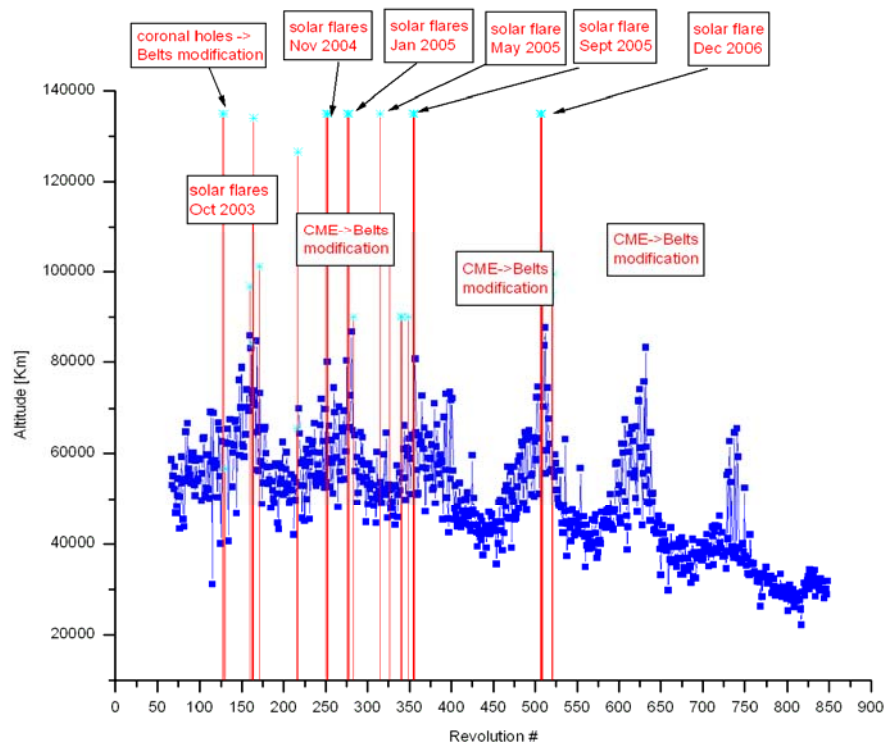
Nothing to report.

On DoY 262 at 12:28:04, DoY 265 at 12:18:12 and DoY 268 at 12:08:44 OMC went to SAFE mode nominally, at the radiation belt entry time as set in the Broadcast Packet.

8.1.6 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]
846	RAD_ENTR R 2009-09-19T12:27:59Z	19/09/2009 14:55:15	29982.7	19-Sep-2009 14:51:56	30174.9
847	RAD_EXIT R 2009-09-19T21:20:32Z	19/09/2009 20:31:39	41575.0	19-Sep-2009 21:01:56	47150.18
847	RAD_ENTR R 2009-09-22T12:18:05Z	22/09/2009 14:50:43	28751.9	22-Sep-2009 14:48:04	29005.09
848	RAD_EXIT R 2009-09-22T21:09:39Z	22/09/2009 20:08:19	39952.1	22-Sep-2009 20:58:04	48258
848	RAD_ENTR R 2009-09-25T12:08:43Z	25/09/2009 14:29:31	31771.3	25-Sep-2009 14:38:04	29461.5
849	RAD_EXIT R 2009-09-25T20:59:51Z	25/09/2009 19:58:35	39977.6	25-Sep-2009 20:48:04	47928.58

Reference

High radiation

Very small error vs reference (less than 10 minutes)

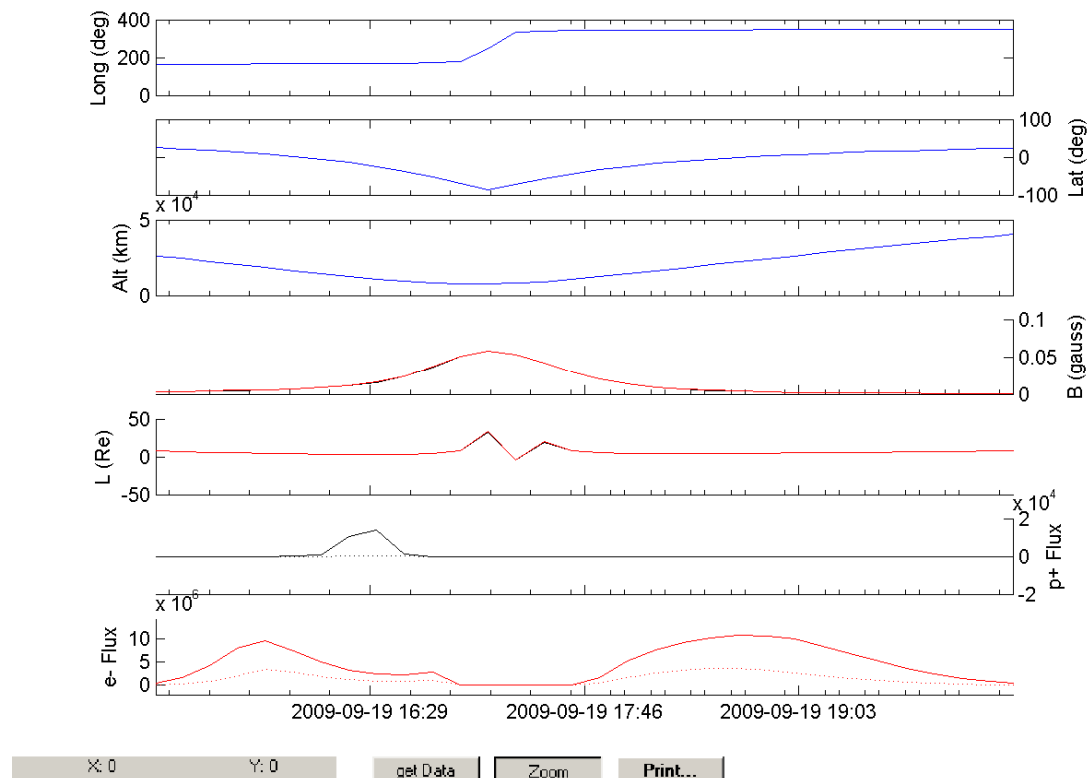
Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

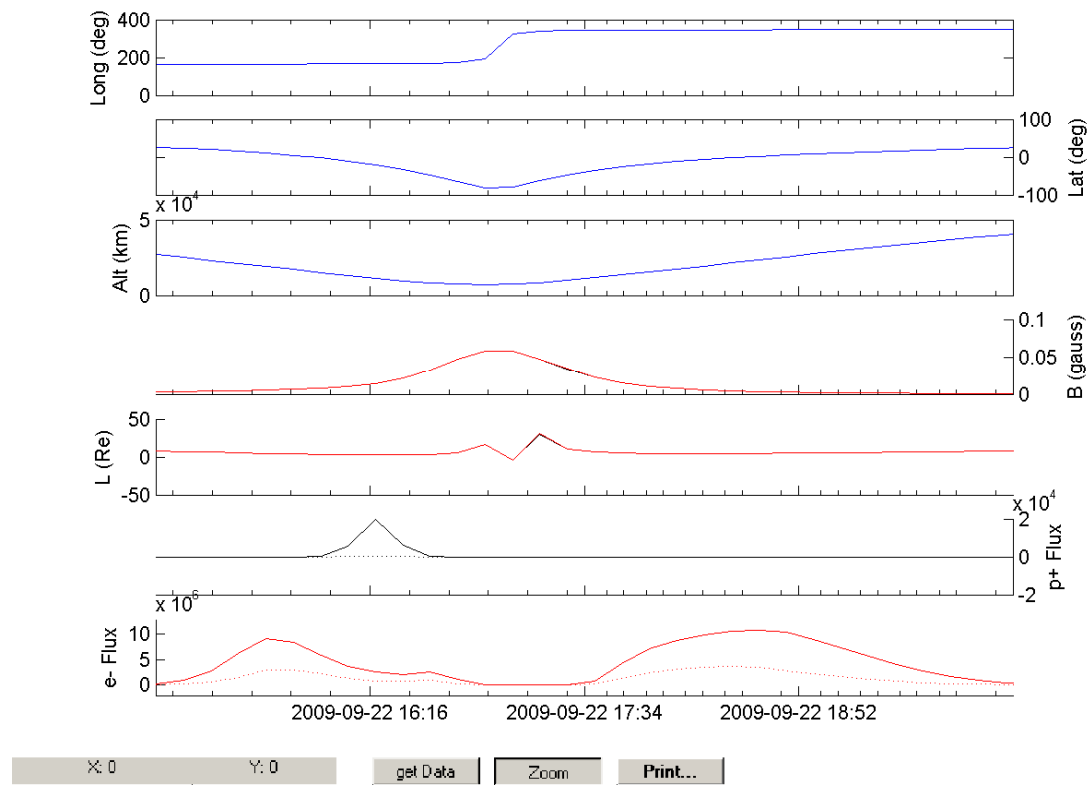
Rad belt entry time ignoring previous threshold crossings where a gap of more than 30 minutes is present.

IREM Predicted Radiation Belt Passages

Rev 846



Rev 847



Rev 848

