

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 099
Week 33
16.08.04
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 07.08.04 until 13.08.04 (both dates inclusive) and covers the revolutions 222, 223 & 224.

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 were the Target of Opportunity SN 2004dj (RA 07:37:17.00; DEC +65:35:57.8), the galactic disk l<0 (RA 16:18:32.00; DEC -50:22:26.0), PSR B1509-58 (RA 15:13:55.62; DEC -59:08:09.0) and GX 339-4 (RA 17:02:49.40; DEC -48:47:22.4). The activities consisted of hexagonal and raster dithering observations.

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.

Due to a high radiation background during the perigee pass on DoY 223, the STR condition was very unstable for a period of about 25 minutes. The guide star was released/lost 26 times during this period. The guide star was also released once during the perigee pass on DoY 226, also because of SEUs.

The fuel consumption over the period between 06/08/2004 and 13/08/2004 was 0.183 kg. The remaining propellant is in the order of 168.804 Kg on the 13th of August.

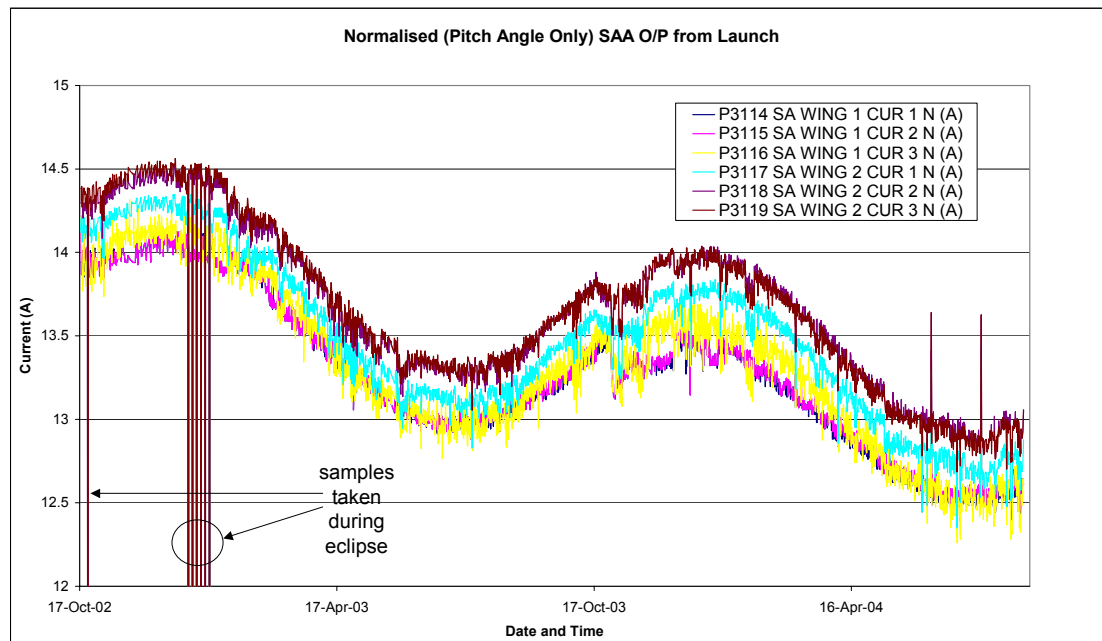
Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix.

3.1.2 Power

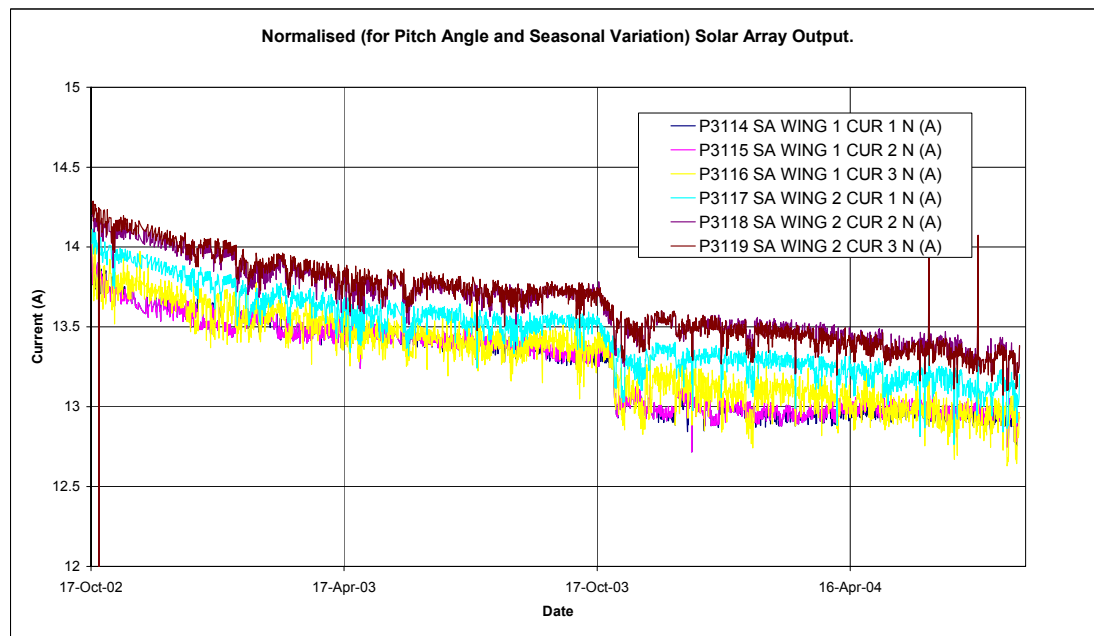
The EPS is working nominally, available power from the arrays is of the order of 2100W.

The following plot shows the evolution of the output of the 6 solar array sections since launch. The effects of changes in pitch angle have been compensated for, however no compensation is made for temperature or roll angle variations. The lower curves are the output of those sections, which are connected to the main bus, the upper

curves are those sections which are dumping power. The seasonal variation in power output can clearly be seen, superimposed on this is the degradation of the arrays.



The next plot shows the same data with a compensation applied to remove the seasonal variation, this gives some idea of the true degradation of the arrays output. Again no compensation is made for temperature or roll angle variations.



In the seasonal worst case the total power output is of the order of 2000W, at the maximum allowed Pitch angle of 40°, the array output will be of the order of 1500W.

During the last eclipse season the maximum observed power consumption (batteries under charge and PLM warming up post eclipse) was less than 1200W.

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 was identified.

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

After the failure of Germanium Detector#17, on 17th July, the overall status of the instrument in this week is nominal, except for the PSD (Pulse Shape Discriminator), which reproduced twice the anomaly of zero counts on all the channel rates, for a few minutes.

The instrument was maintained in photon-by-photon mode with spectra TM enabled, an assigned TM bandwidth in the science windows of 103 pkts/cycle and an actual average occupation of 91.6 pkts/cycle.

The cryo-cooler is working well, maintaining the temperature within 85+/-1K.

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

3.2.2 IBIS

The overall status of the unit is Nominal.

During the reporting period the PST Allocation to IBIS was 129 TMSP / Cycle. The mean IBIS Bandwidth usage was 103.9 TMSP / Cycle, up 4.0 TMSP on last week.

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 during science observations; with a TM allocation of 8 packets/cycle. JEM-X2 was dormant with a TM allocation of 1 packet/cycle.

Further information on the JEM-X operations can be found in the Appendix Section 8.3.4.

3.2.4 OMC

The status of OMC is nominal.

During the reporting period OMC operations were performed by the automatic timeline, with the TM allocation to OMC of 5 packets/cycle.

There were 127 OMC pointings executed nominally, none were lost.

Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is Nominal.

Solar Activity

The observation period was still characterized by the influence of the past and recent solar activity on the structure of the Radiation Belts. The inner part of the Belts passage did not present the typical footprint due to the Integral orbit, but appeared compressed around the perigee area.

The proton counter presented still high peak during each Belts passages for rev 221-222-223, some orders of magnitude over the typical values.

The Sunspot 649, which generated five X-class solar flares in July, returned to grow and to harbour energy for X solar flares.

The following major event was reported during the observation period:

X-ray Event exceeded X1 class

begin time : at 2004 Aug 13 18:07Z

end time: at 2004 Aug 13 18:15Z.

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

4 Ground Facilities

The performance of the Operational ground facilities was very good this week, well above the system performance requirements, no pointings were lost.

4.1 Mission Operations Centre

The performance of the MOC was in general good in the reporting period, there was an instance where problems were experienced sending data to the isds, but apart from that, another quiet week.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There were some minor problems with bad frames and TM drops from both stations,

there were also problems sending STDMS, but no pointings were lost. The overall performance though was nearly 100%.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSFs: up to 229 received

POS and POD: POS / POD sent up to rev 227.

TSFs: complete up to revolution 224. TSF for rev 224 is updated to include the latest re-planning. See below

This week has again seen re-planning of rev 224 to accommodate an accepted ToO of the black hole candidate / x-ray transient GX339-4. In revolution 228 it is planned to start the second cycle of the GCDE of the core program. Revolution 229 is planned to use the updated ISOC version 10.5 with the enhanced dither pattern. See below.

2. Observation status

All ECS's received up to rev 212. OCS's sent except for 207. The problem of too little good times reported last week as been assessed and agreed with the Project Scientist. No extra time credited. Rev 207 has no good time for ISGRI in the ECS from ISDC. This case is being investigated by ISDC.

3. ISOC science data archive

Tape with science windows up to rev 195 received and ingested. Browser version 1.1 now in use in ISOC. Next step is to "integrate" the INTEGRAL archive at ISOC with the existing ESA archives, E.g. XMM-Newton and ISO.

4. ISOC system

The ISOC system version 10.4 patch 5 is still in use. A new version 10.5 is now undergoing final testing. It is planned to introduce it operationally next week. The main modifications in this version is the introductions of an enhanced 5 x 5 dither pattern as agreed with the ISWT. It also contains enhancements to the functions to copy observations and introducing the capability to copy entire proposals.

5. Problems

No new problems.

4.3.2 ISDC

Status of ISDC observation processing on 16/08/2004:

- Latest Standard Analysis completed: observation 02201510001 (NGC 5548, Revolution 204) on 16/08/2004

- Latest products archived: amalgamated observations 02200210001, 02201030001, 02297000004 (Carina, Revolution 197-200) on 30/07/2004

- Latest observation products sent to the observer: amalgamated observations 02200210001, 02201030001, 02297000004 (Carina, Revolution 197-200) on 07/08/2004

5 Special Events

6 Anomalies

There were a number of problems related to the ground segment that impacted the operations:

- On DoY 220, from 01:09 through to the end of the pass at 07:22, there were repeated bad frames from DSS-16. The TM & TC links also dropped at 05:07, 05:13, 06:00 and 06:06, there was no apparent impact to the timeline, the corresponding DR# is N102290.
- On DoY 220 at 01:46, there was an error sending data to the consolidator, followed by errors sending data to the isds. The system recovered autonomously without intervention or impact.
- At 11:39, there were frequent drops in TM from Redu, GFCC reported they were having problems sending STDMS, the antenna was switched to autotrack solving the immediate problem. At 15:30, a test was conducted using program track, which then performed nominally.
- On DoY 221, at 04:00, the imca was showing yellow due to insufficient swap space, the MMI application launchers were restarted curing the problem.
- On DoY 223, at 00:35, due to a problem with the FEC at Redu, the links were lost, as DSS-16 had been tracking INTEGRAL since 00:22, the handover was brought forward, and the lost TM could be recovered from DSS-16 later, there was no impact.
- Later, at 03:37, 15 bad frames were received, then at 03:42, 8 more bad frames were received from DSS-16. The station reported no problems though. There was no impact.
- On DoY 225, at 19:08, the antenna at Redu stopped moving, Network immediately switched it to program-track, recovering the situation. The only impact was a brief drop in received power. No TM was lost.
- Later at 22:33, there was a brief drop in VC0 and VC7 TM from Redu, there was no impact.
- On DoY 226, at 16:54 there were a series of errors indicating problems sending data to the isds. Procedure TM Data not routed to ISDC was run, and at 19:14, the problem was finally cleared. The problem appears to have been network related.

The following new anomaly reports were entered into the ARTS system for last week.

AR id	Date Occurrence	Subject	Segment	Status
INT_SC-90	10/08/2004	SPI PSD (Pulse Shape Discriminator) channel rates malfunction	Payload	Pending
INT-2628	17/08/2004	FDS failed to generate autom. TPF	FDS	Pending
INT-2629	17/08/2004	FDS failed to generate autom. TPF	FDS	Pending
INT-2630	17/08/2004	Several TC/TM drops at DSS-16	NASA	Pending

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			Station	
INT-2631	17/08/2004	Track at REDU stopped.	ESA Stations	Pending
INT-2632	17/08/2004	Error sending data to ISDC due to LAN problem	COMMS	Pending

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 222

The observations in revolution 222 consisted of a hexagonal dithering observation of the Target of Opportunity SN 2004dj (RA 07:37:17.00; DEC +65:35:57.8) lasting ~24 hours, followed by an amalgamated raster dithering observation of the galactic disk $l < 0$ (RA 16:18:32.00; DEC -50:22:26.0), performed for the remaining ~34 hours of observation time.

Revolution 223

The observations in revolution 223 consisted of an amalgamated raster dithering observation of PSR B1509-58 (RA 15:13:55.62; DEC -59:08:09.0) lasting ~9 hours, followed by an amalgamated raster dithering observation of the galactic disk $l < 0$ (RA 16:18:32.00; DEC -50:22:26.0), performed for the remaining ~53 hours of observation time.

Revolution 224

The observations in revolution 224 consisted of a hexagonal dithering observation of the Target of Opportunity SN 2004dj (RA 07:37:17.00; DEC +65:35:57.8) lasting ~28.5 hours, followed by a raster dithering observation of GX 339-4 (RA 17:02:49.40; DEC -48:47:22.4), performed for the remaining ~30.5 hours of observation time.

Throughout these observations all instruments were in their nominal science modes, except for JEM-X2, which was in Safe mode, and the TM allocation was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2004-07-29T14:58:27.000Z	169.1691	F	Automatic TM processing.
2004-07-30T22:51:26.000Z	169.1619	F	Automatic TM processing.
2004-08-01T07:26:02.000Z	169.1397	F	Automatic TM processing.
2004-08-01T12:35:22.000Z	169.0780	F	Automatic TM processing.
2004-08-02T22:45:18.000Z	169.0560	F	Automatic TM processing.
2004-08-04T07:15:05.000Z	169.0420	F	Automatic TM processing.
2004-08-04T12:22:17.000Z	169.0200	F	Automatic TM processing.
2004-08-04T18:37:14.000Z	168.9870	F	Automatic TM processing.
2004-08-07T07:01:44.000Z	168.9750	F	Automatic TM processing.
2004-08-07T12:14:01.000Z	168.9236	F	Automatic TM processing.
2004-08-08T15:06:35.000Z	168.8940	F	Automatic TM processing.
2004-08-08T16:47:24.000Z	168.8735	F	Automatic TM processing.
2004-08-08T22:54:52.000Z	168.8575	F	Automatic TM processing.
2004-08-10T11:51:12.000Z	168.8414	F	Automatic TM processing.
2004-08-11T23:02:12.000Z	168.8037	F	Automatic TM processing.

This report was generated Fri Aug 13 08:00:17 GMT 2004

8.3 Detailed Satellite Information

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

8.3.1 AOCS Summary Operations Report 07/08/2004-13/08/2004

AOCS operations were executed from the Automatic Timeline.

During this period, 39 Open Loop Slews, 104 Closed Loop Slews and 8 Momentum Bias were executed. No slews were lost or executed manually.

07/08/04 (Day of Year 220, Revolution 221-222)

Nothing to report.

08/08/04 (Day of Year 221, Revolution 222)

Nothing to report.

09/08/04 (Day of Year 222, Revolution 222)

Nothing to report.

10/08/04 (Day of Year 223, Revolution 222-223)

Guide star released by the STR SEU Filter during perigee passage: At 10:47:47, the SEU Filter threshold of the ACC exceeded and the guide star was released. At LOS the magnitude 6.45 guide star was located at [19418, 5258]. From this time until 11:11:11, the guide star was released/lost 26 times because of the high radiation background. At AOS the new guide star was located at [16694, -6299].

11/08/04 (Day of Year 224, Revolution 223)

Nothing to report.

12/08/04 (Day of Year 225, Revolution 223)

Nothing to report.

13/08/04 (Day of Year 226, Revolution 223-224)

Guide star released by the STR SEU Filter during perigee passage: At 10:25:28, the STR SEU Filter threshold was exceeded and the magnitude 5.7 guide star was released. At LOS, the guide star was at [16121, -9648]. A new guide star was found in the first automatic mapping, which was kept afterwards. At AOS: [23251, -7605] 5.15 Mi.

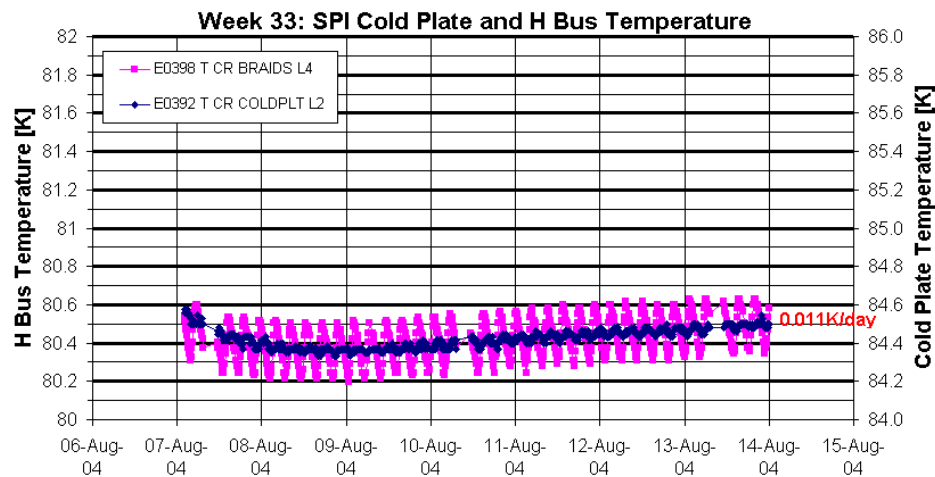
8.3.2 SPI Operations

Cryo-cooler / Detector Cold-Plate:

The performance of the cryo-cooler is nominal.

The cold plate temperature was maintained at 85K $\pm$ 1K though still showed a notable positive drift, present since the last annealing cycle, completed on 30th June. The SPI PI has been contacted to provide an assessment and confirmed that the increased drift is still to be considered nominal

The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.

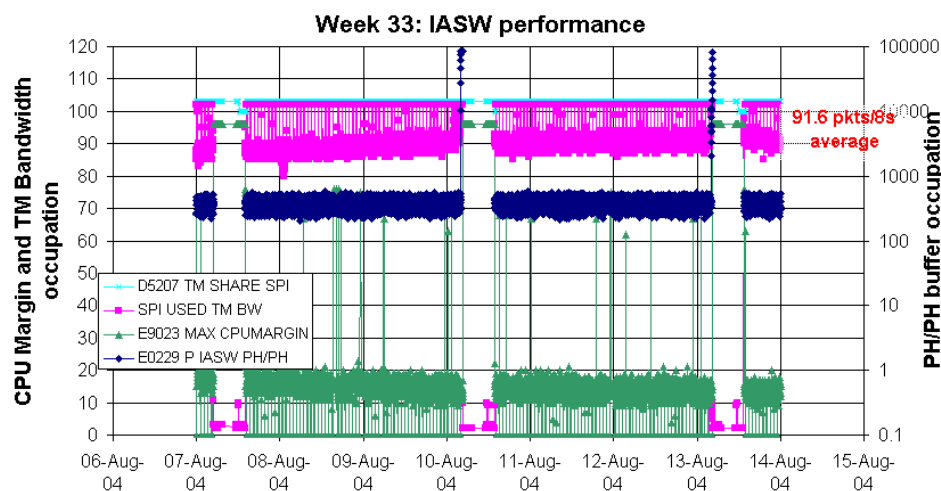


IASW/DPE:

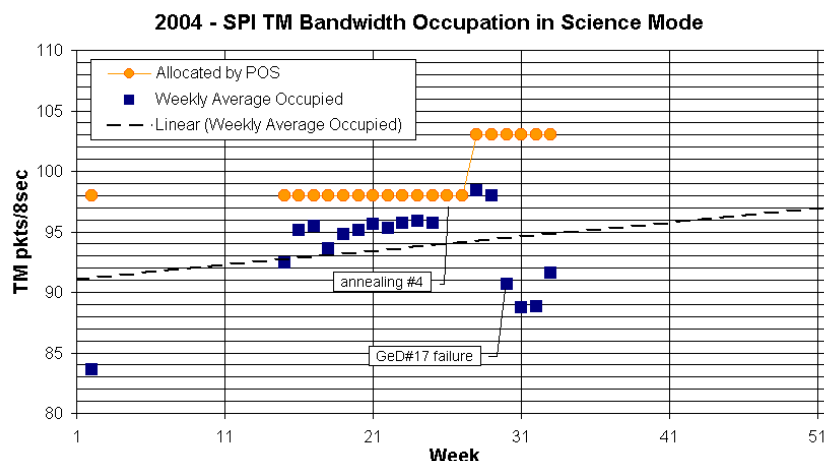
The performance of the IASW/DPE is nominal.

The average TM bandwidth occupation was 91.6 pkts/cycle in the science windows.

The following diagram shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



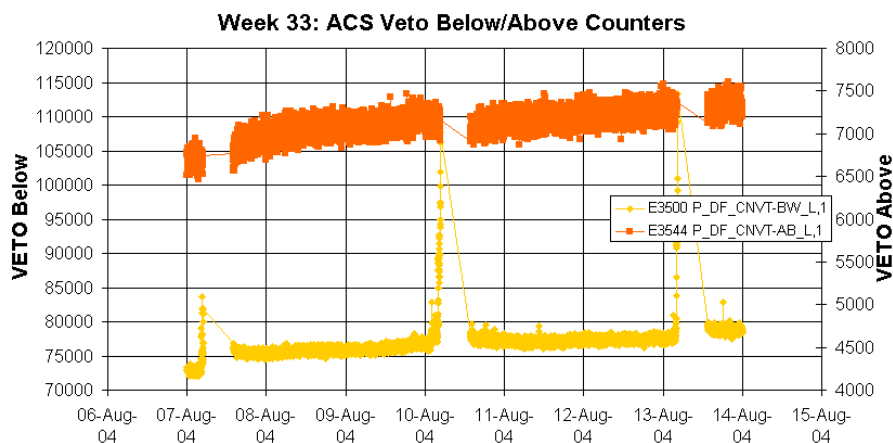
The following plot shows the trend of the occupied bandwidth, since beginning of 2004.



ACS:

The performance of the ACS is nominal.

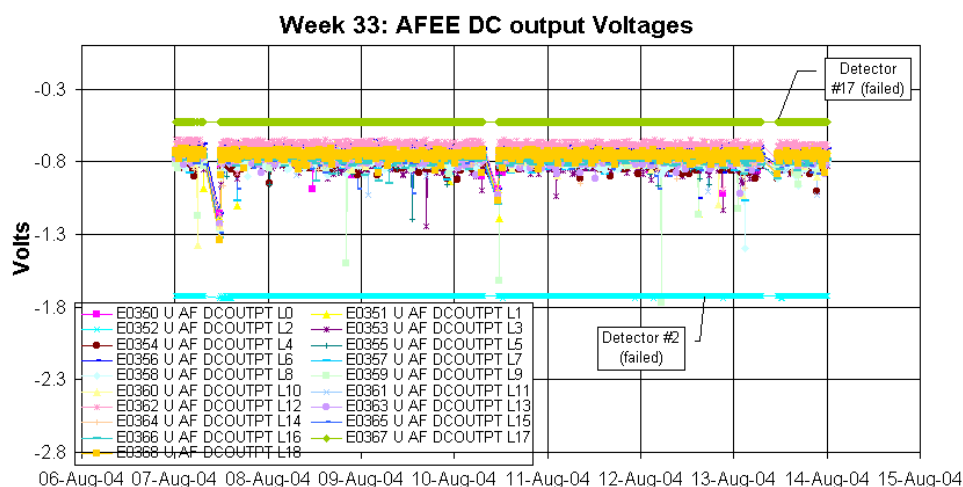
The following plot shows the ACS overall count rate evolution during the reporting period.



AFEE:

The performance of the detectors is nominal except for the detector #2, failed since 06.12.2003, and detector #17, failed since 17.07.2004.

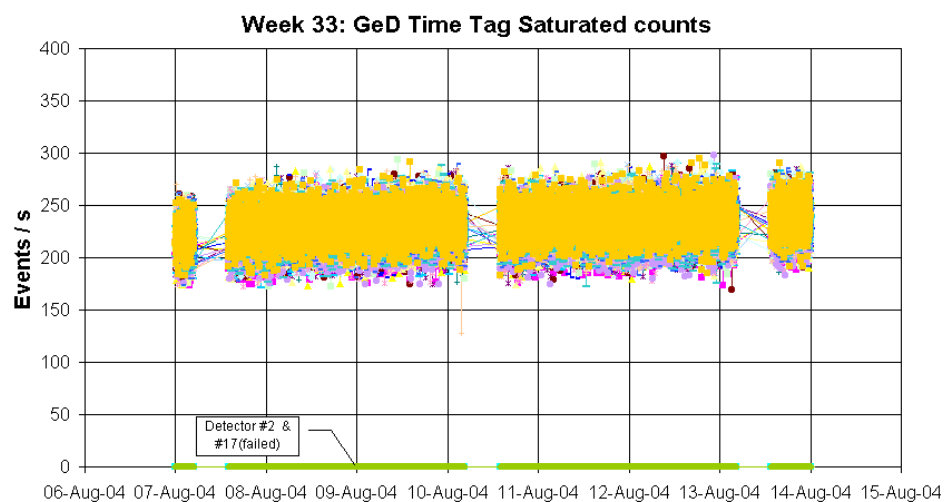
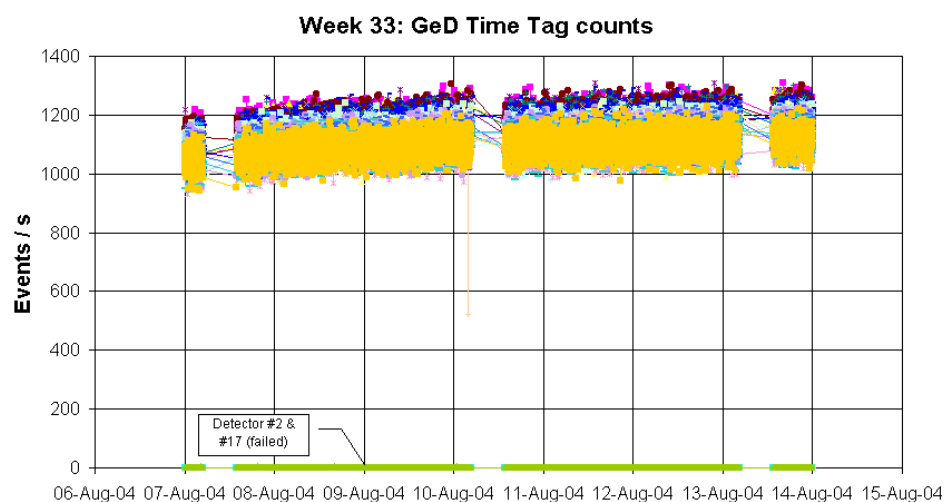
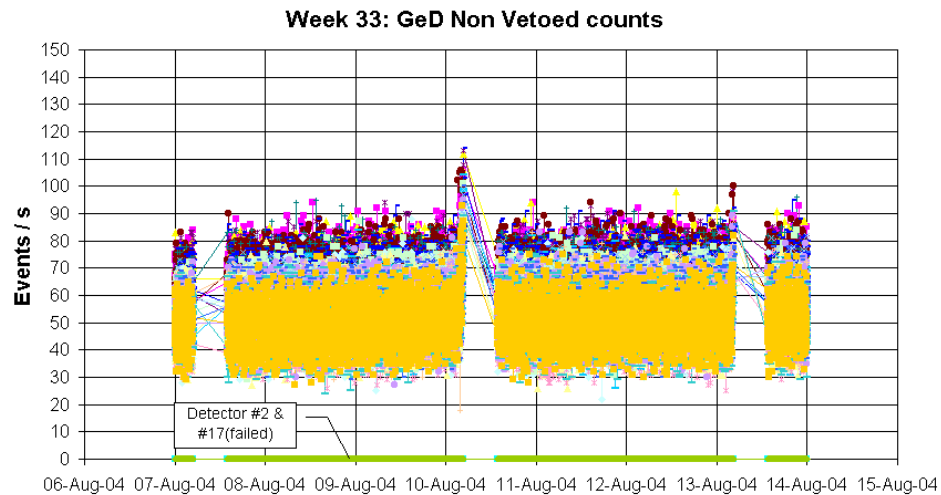
The following plot shows the AFEE dc output signals during the reporting period.



DFEE:

The performance of the unit is nominal.

The following plot shows the GeD Time Tagged, Time Tagged Saturating and Non Vetoed event rates processed by the DFEE during the reporting period. The count rate of each detector is within the expected range, except for the failed detector #2 and #17.



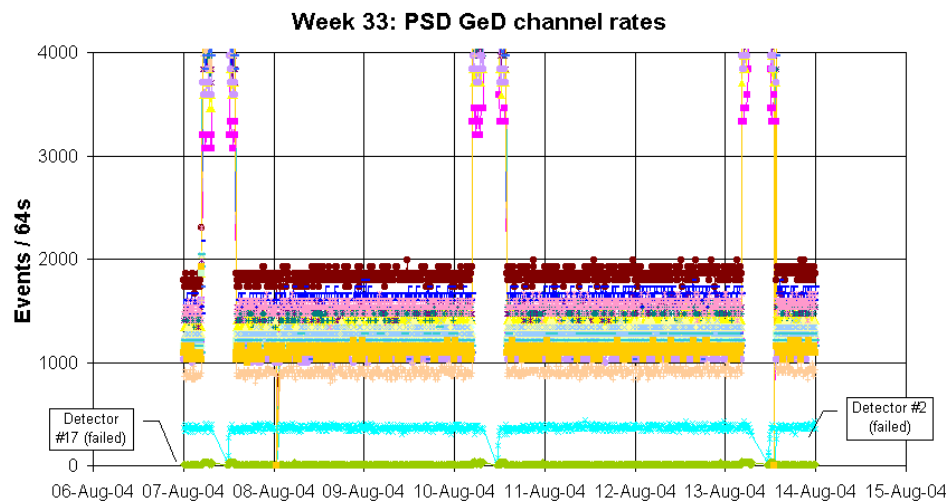
PSD:

The performance of the unit is nominal, though the malfunction recorded as AR INT_SC-90 (all PSD channel rates to zero counts for a few minutes) occurred twice on 08th at 08:48:10z and 13:04:10z 13th August.

The anomaly affected only the PSD locally as the GeD count rates measured by the DFEE (see above) were still nominal; also the dc output voltage showed a nominal pattern during the malfunction.

This anomaly was first recorded the day after the GeD#17 failure and present explanations correlate it to this failure. A possible recovery procedure is under discussion with the PI.

The following plot shows the PSD channel rates during the reporting period.

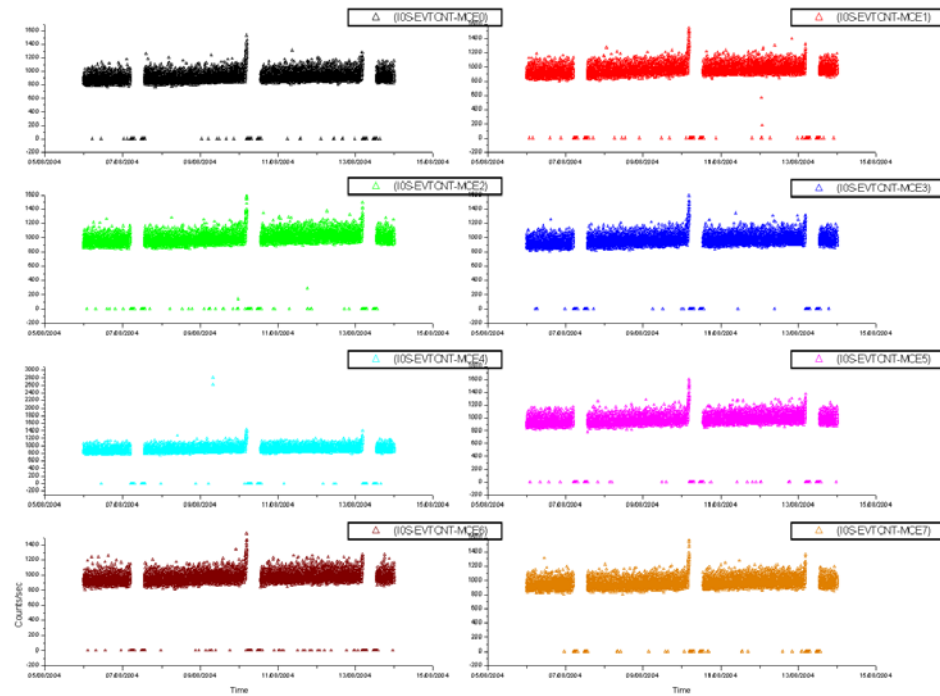


8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

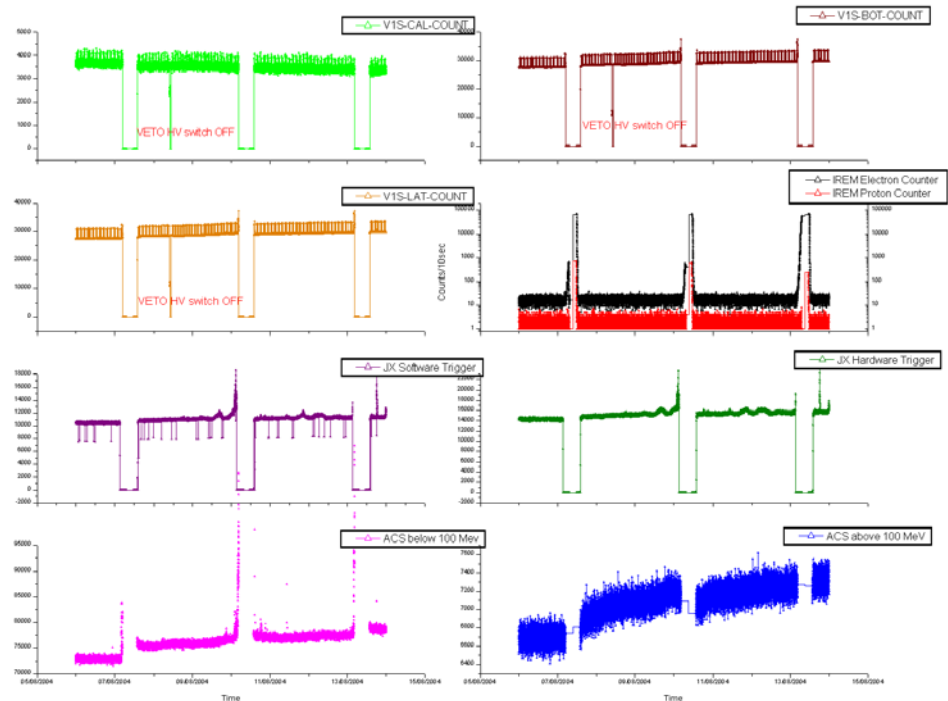
IBIS - ISGRI Counters Rev 222-223



VETO vs Payloads Counters:

The comparison between the count-rates reported by VETO, the SPI-ACS, the IREM counters and JEM-X hardware/software triggers, gives an indication of increasing of the radiation background consequent the recent solar activity from sunspot 649. As observed in the past, this should be only a temporary effect which will progressively disappear in the following revolutions.

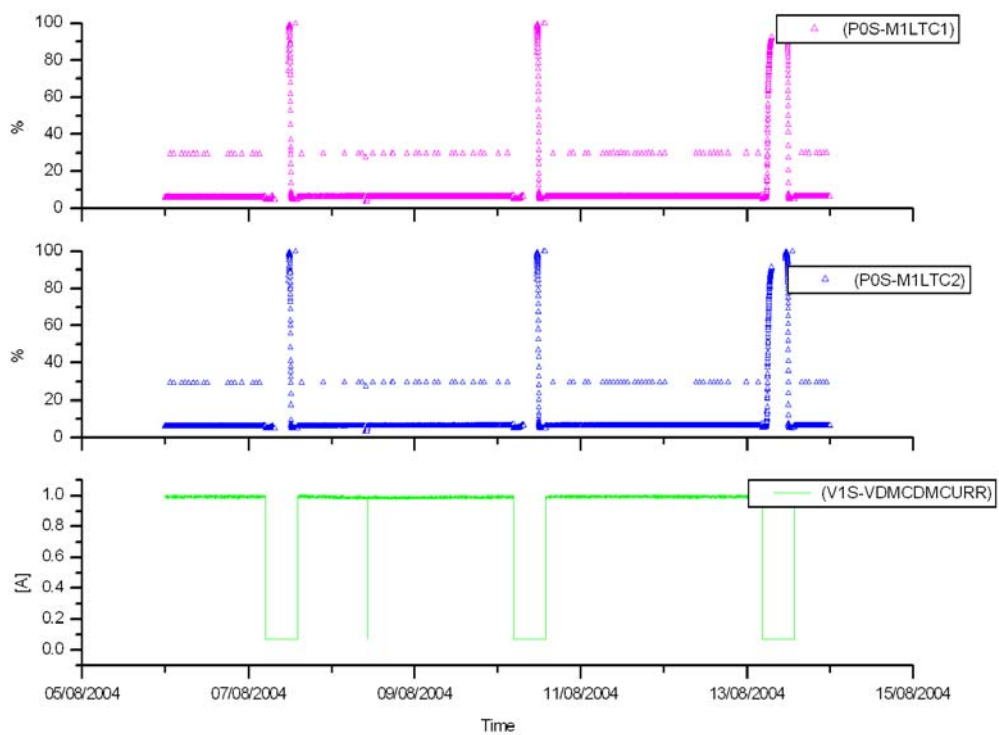
IBIS-VETO vs Payloads Counters Rev 222-223



*with the exception of IREM counters (counts/10sec), all the plots are reporting counts/sec

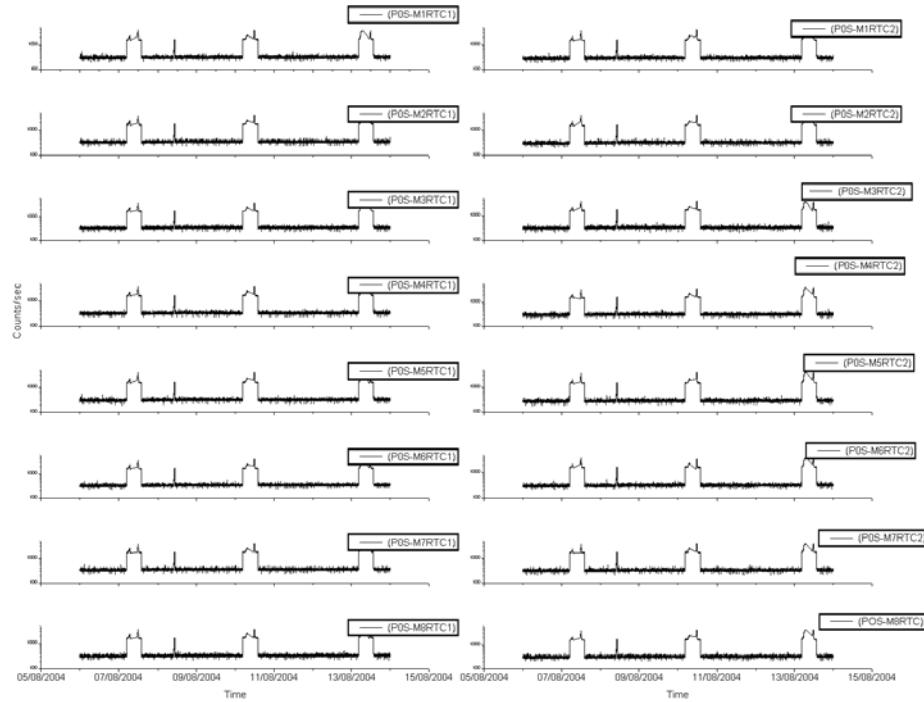
Veto Current:

IBIS-VETO Current & PICsIT dead times Rev 222-223



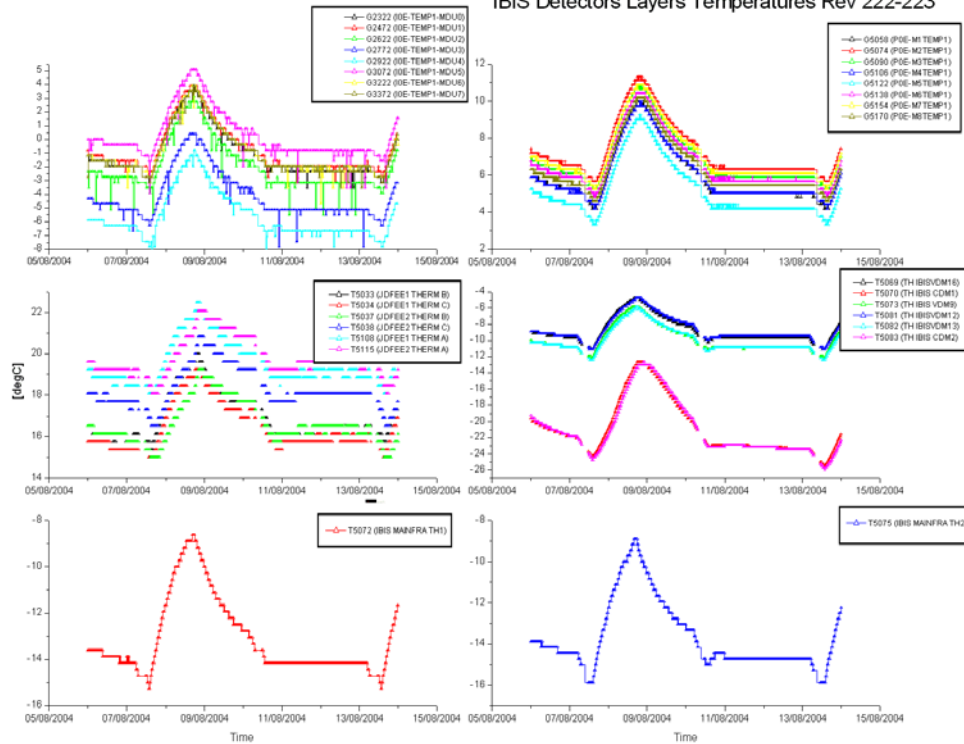
Picsit Counters

IBIS - PICsIT Counters Rev 222-223



IBIS Detectors Layers Temperatures

IBIS Detectors Layers Temperatures Rev 222-223



IBIS daily report

DoY 2004.220 (07/08/04)

Nothing to report.

DoY 2004.221 (08/07/04)

At 09:47Z the parameter G6061 (counter for VETO calibration unit) reported in alarm low. After consultation with the IBIS SOE it was decided to switch OFF the VETO high voltages (by cycling the VETO mode Nominal/Stand-By) for 5 minutes. After the transition back to Standard Mode the parameter G6061 reported value within limits. No further action was taken.

DoY 2004.222 (09/08/04)

Nothing to report.

DoY 2004.223 (10/08/04)

Nothing to report.

DoY 2004.224 (11/08/04)

Nothing to report.

DoY 2004.225 (12/08/04)

Nothing to report.

DoY 2004.226 (13/08/04)

There were a few reports during the Belt passage of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> due to the PICsIT detectors being ON without the VETO anticoincidence system, as required by the PIs.

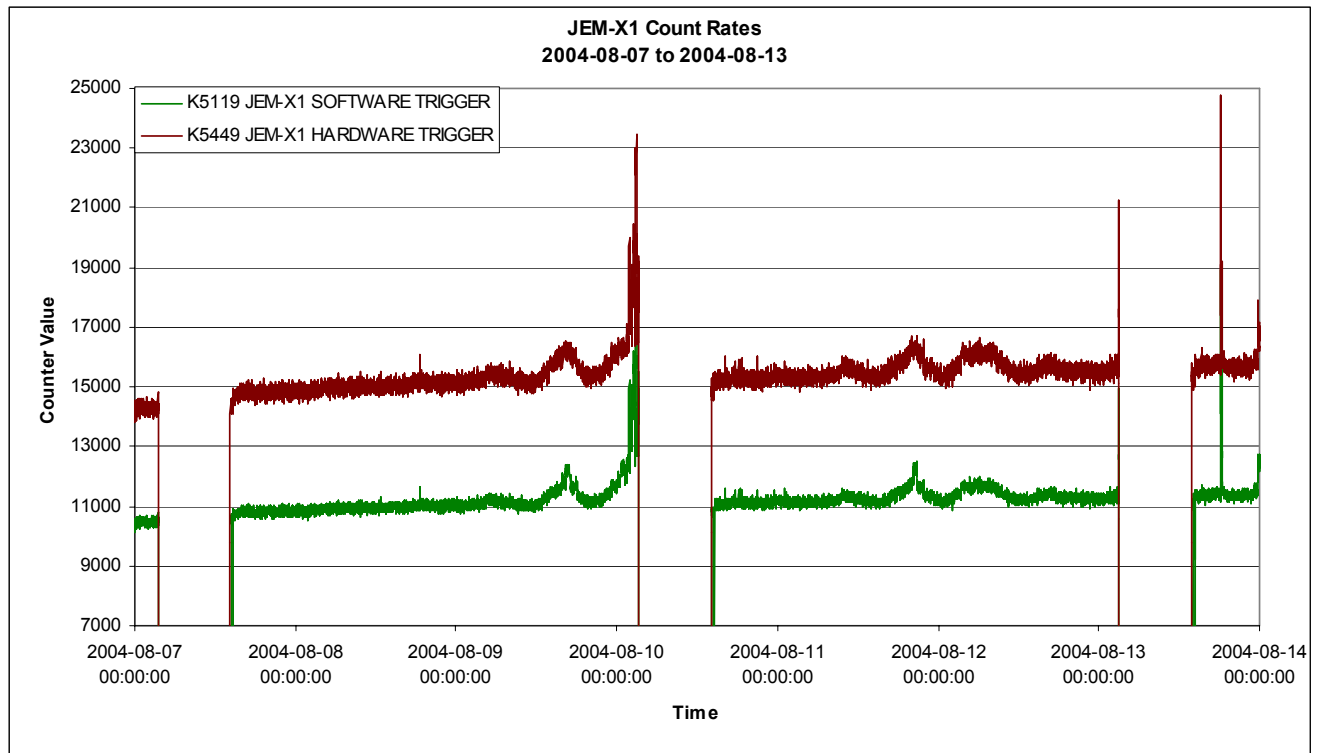
During the Radiation Belt passage, the TM parameter families G5002 and G5003 (PDM: counter semimodule #.) showed 'warning high' several times for few TM Cycles. This was due to the PICsIT detectors being ON without the VETO anticoincidence system, during Belt passages. No further action was taken.

At 13:23Z the parameter G2014 (Overflow of the noisy pixel address buffer in MCE1) failed the SCC (OOL). The parameter showed an overflow of the number of noisy pixels for the ISGRI detector module # 1. The parameter returned within limits after few TM cycles. No further action was taken.

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

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

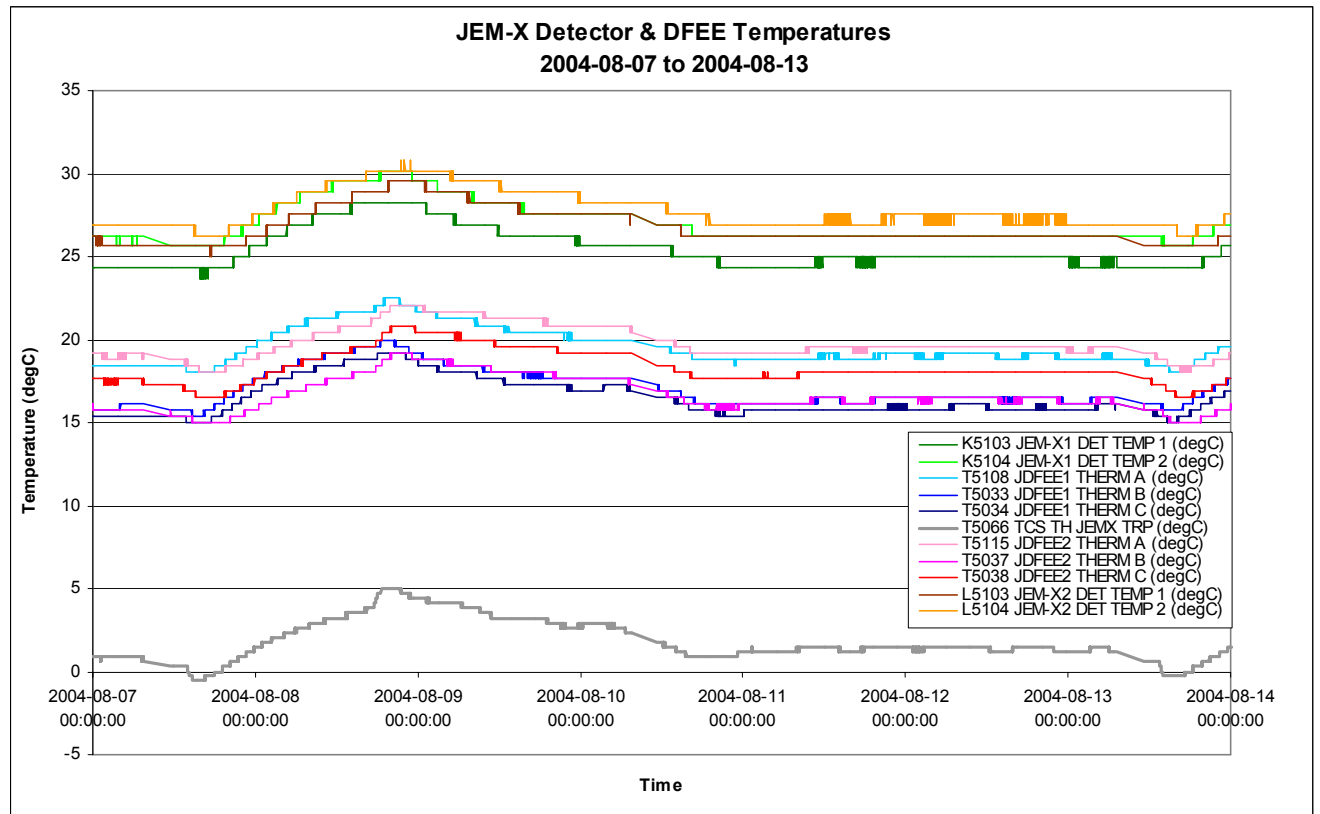


8.3.4.2 JEM-X Temperatures

The JEM-X1 and JEM-X2 detector temperatures over the reporting period are displayed in the following graph, along with the temperatures at a selection of DFEE locations and on the detector bench between the two units².

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

² Data sampled (1 frame in 8)



8.3.4.3 JEM-X Daily Report

2004-08-07 (DoY 220, Rev 221-222) to 2004-08-12 (DoY 225, Rev 223)

Nothing to report

2004-08-13 (DoY 226, Rev 223-224)

At 18:11:37Z the TM parameter K5136 Buffer Loss went out of limits (value = 258). It reached a maximum value of 691 at 18:11:53Z and returned within limits at 18:12:09Z.

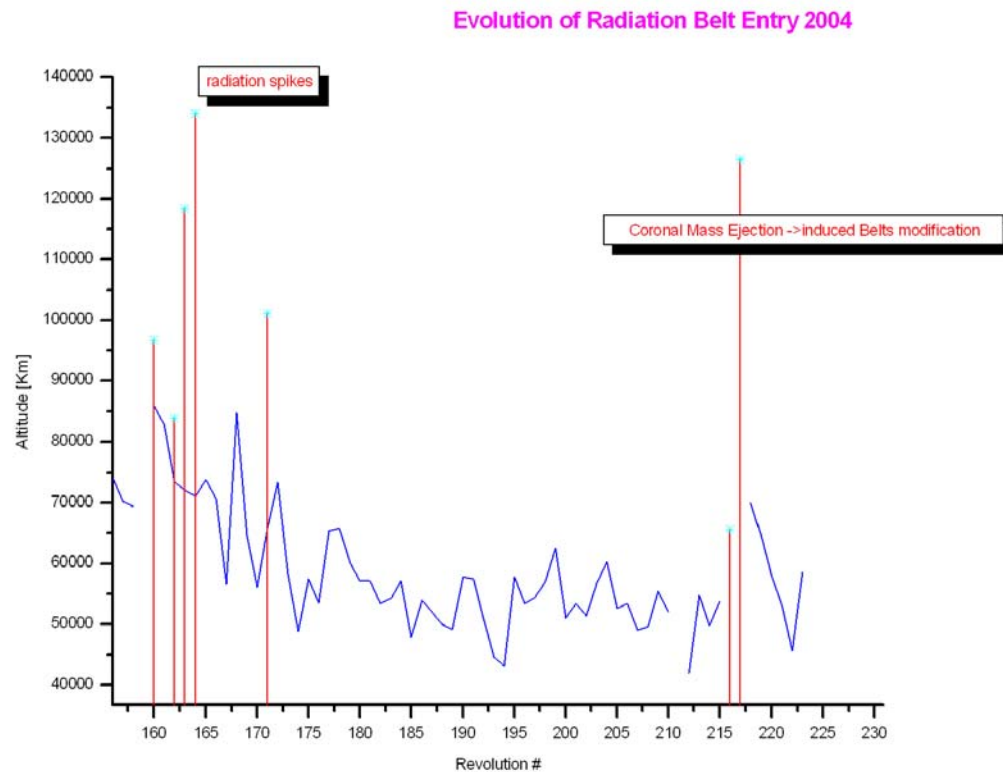
8.3.5 OMC Operations

Nothing to report.

On DoY 220 at 04:51:31, DoY 223 at 04:38:34, and DoY 226 at 04:22:14, OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



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]
221	RAD ENTR R 2004-08-07T04:51:09Z	2004-08-07 05:46:58	53013.0	07-Aug-2004 05:38	53438
222	RAD EXIT R 2004-08-07T13:57:23Z	2004-08-07 12:25:06	24846.5	07-Aug-2004 12:38	27476
222	RAD ENTR R 2004-08-10T04:38:14Z	2004-08-10 06:21:54	45654.2	10-Aug-2004 05:20	54236
223	RAD EXIT R 2004-08-10T13:44:51Z	2004-08-10 12:14:34	>23165.9	10-Aug-2004 12:30	28105
223	RAD ENTR R 2004-08-13T04:21:57Z	2004-08-13 04:39:22	58570.5	13-Aug-2004 05:10	53840
224	RAD EXIT R 2004-08-13T13:28:37Z	2004-08-13 12:09:06	27068.6	13-Aug-2004 12:20	28586

Reference

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)

Radiation Spike

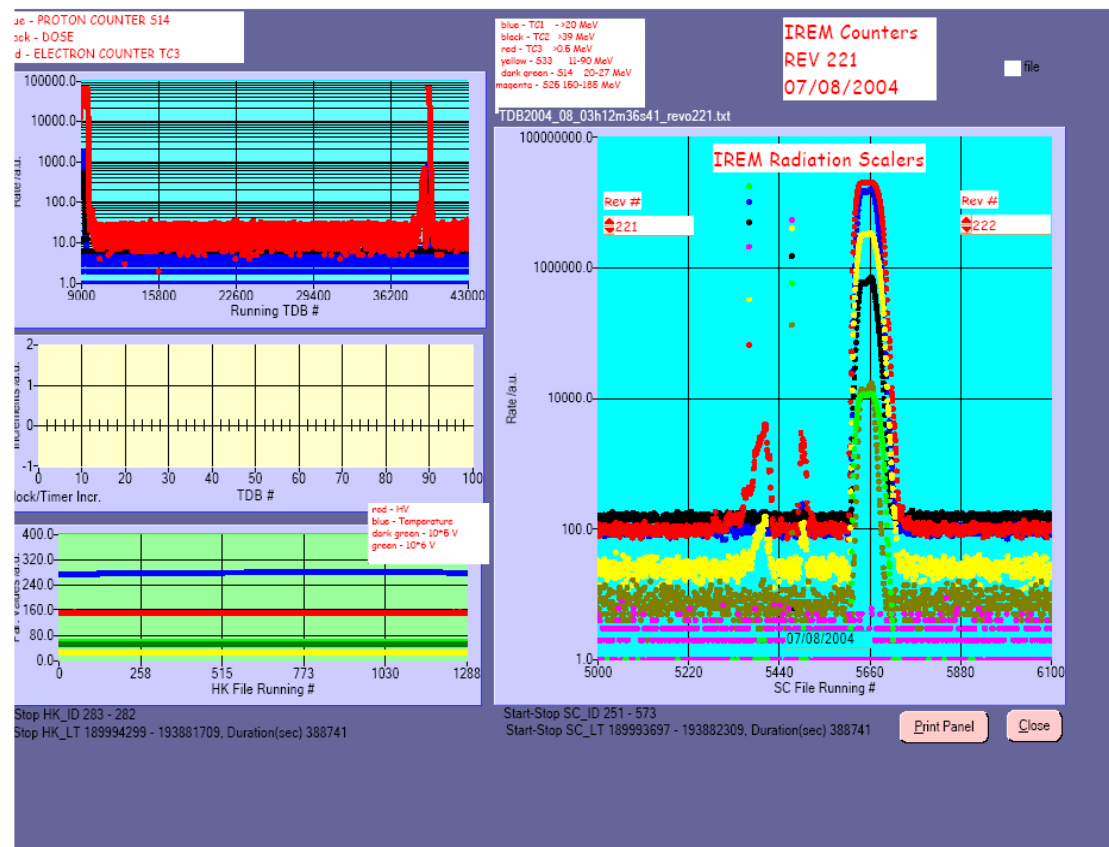
Proton Belts

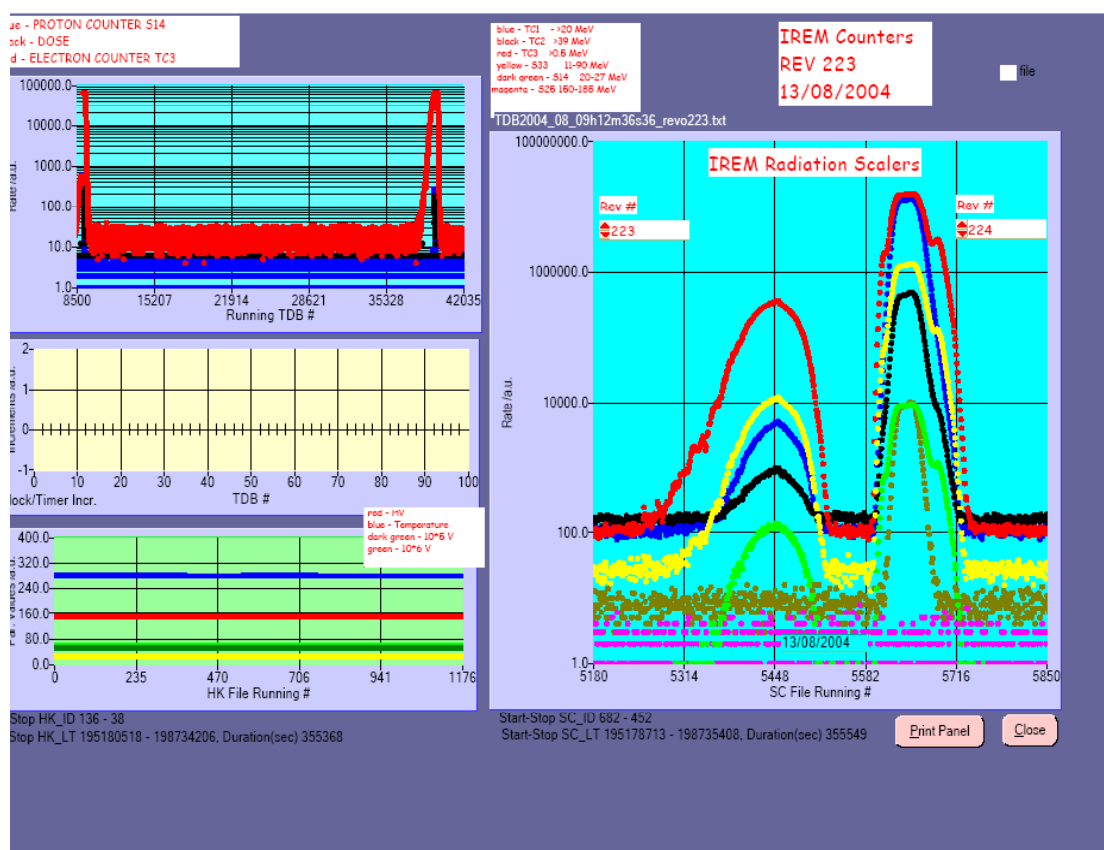
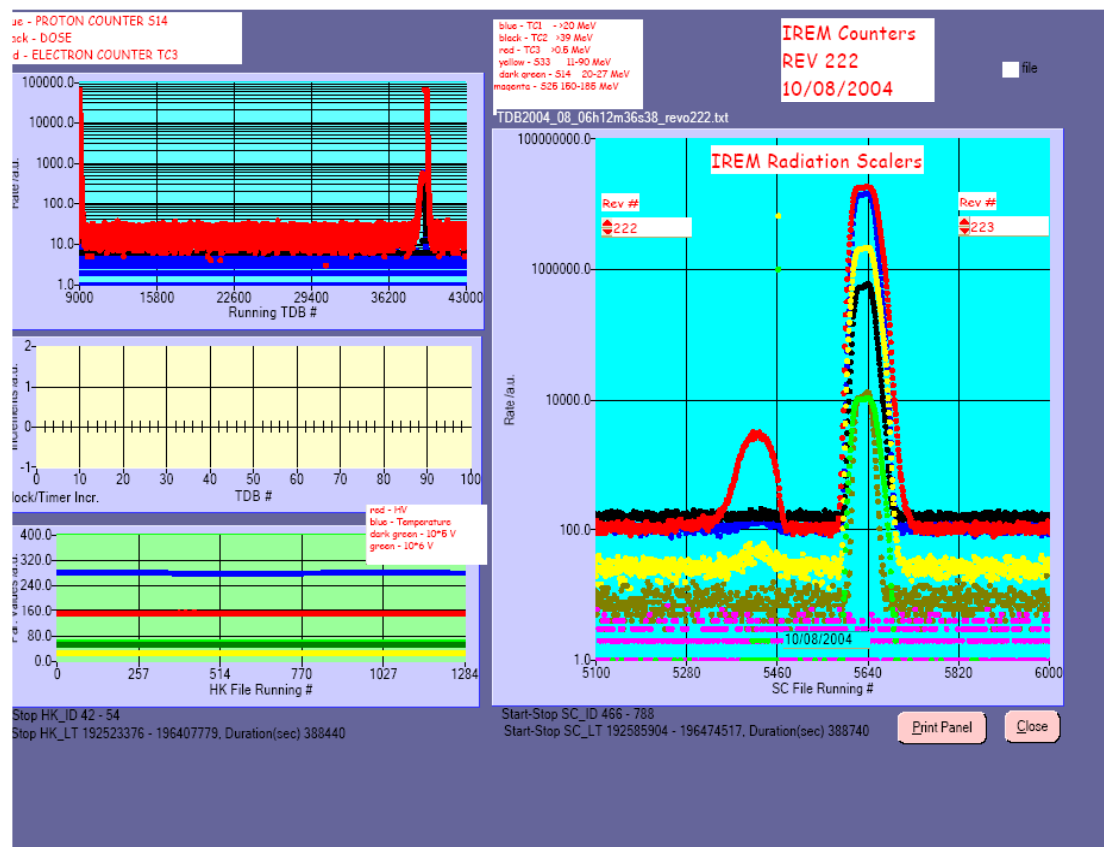
REV		Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
221	PROTON_RAD_ENTR	07-Aug-2004 10:58	12534
222	PROTON_RAD_EXIT	07-Aug-2004 11:18	14704
222	PROTON_RAD_ENTR	10-Aug-2004 10:50	12957
223	PROTON_RAD_EXIT	10-Aug-2004 11:10	15264
223	PROTON_RAD_ENTR	13-Aug-2004 10:40	13242
224	PROTON_RAD_EXIT	13-Aug-2004 11:00	15659

IREM daily report

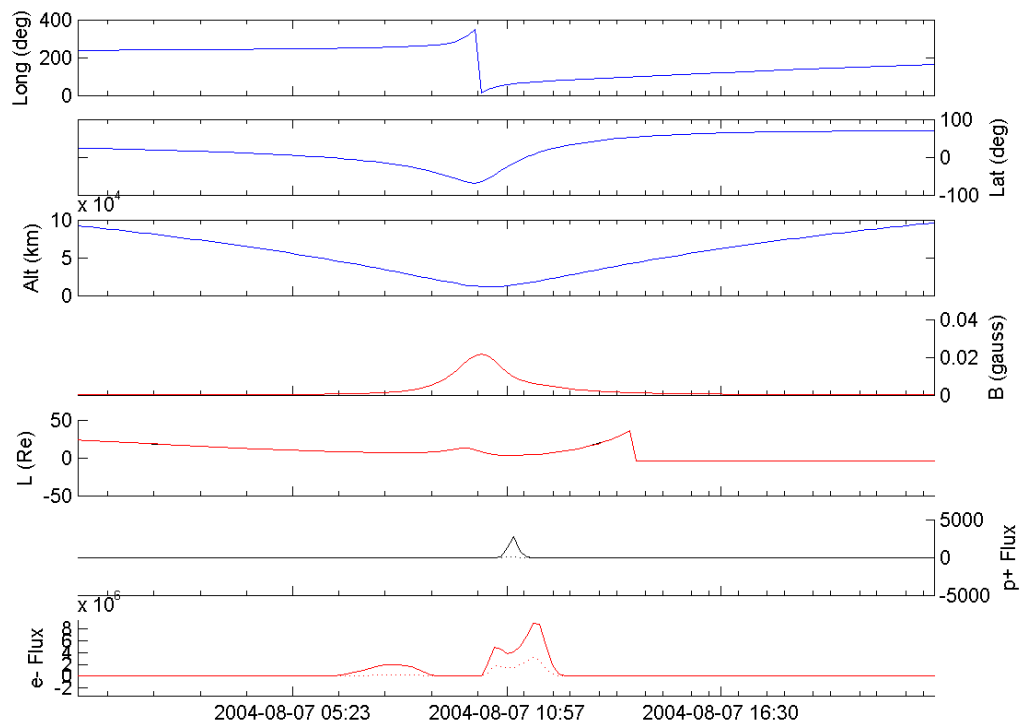
Nothing to report.

IREM radiation counters

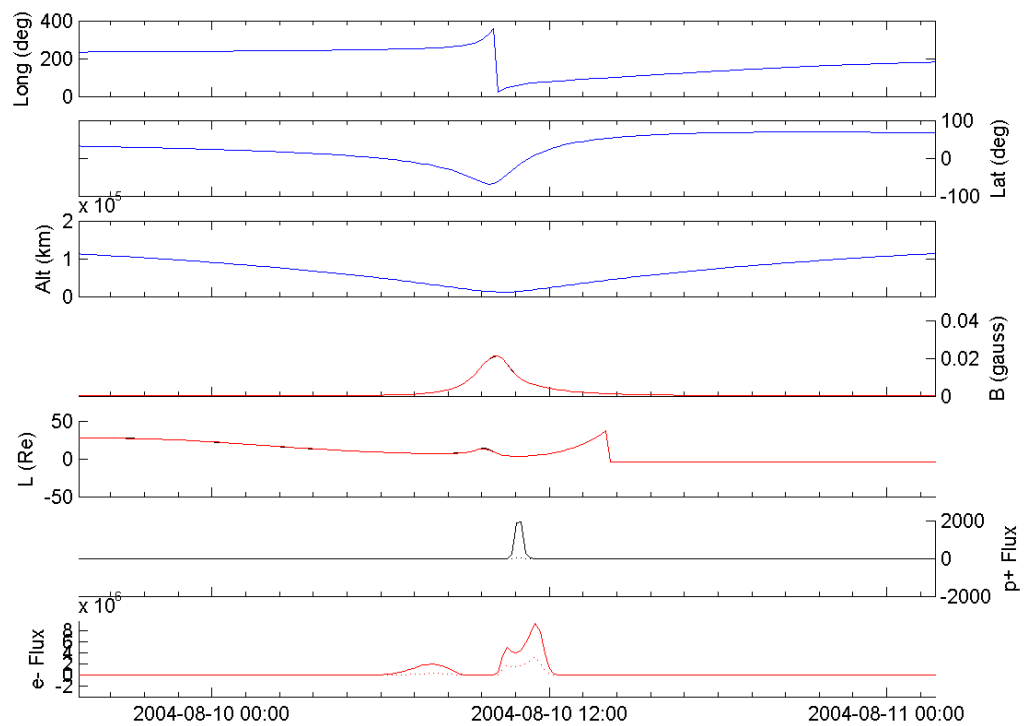




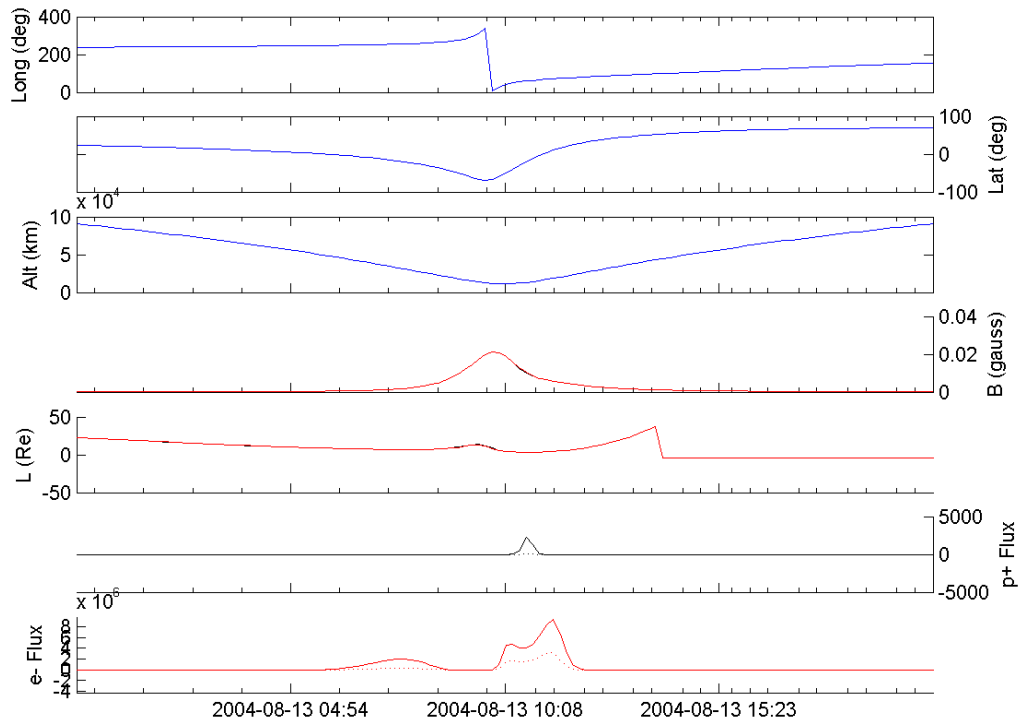
IREM Predicted Radiation Belt Passages. Rev 221



Rev 222



Rev 223



SEC-GOES Observed Particles Fluxes.

