

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-TOS-OF
No. 085
Week 19
10.05.04
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 01.05.04 until 07.05.04 (both dates inclusive) and covers the revolutions 189, 190 & 191.

2 Summary of Activities

The operations were performed according to the planning inputs from ISOC combined with some manual commanding by MOC.

The target of these revolutions were the Galactic Plane, the Sagittarius Arm tangent (RA 19:00:1.43; DEC +06:55:17.0), Cygnus X (RA 21:13:12.00; DEC +41:15:58.0), an OMC Flat Field (RA 19:19:12.00; DEC +61:54:00.0) and an amalgamated observation of Cygnus X, WR140, WR146, WR147 and Cyg OB2 centred at (RA 20:33:10.00; DEC +41:12:00.0). The activities consisted of GPS, raster dithering and staring observations. In addition, OMC Flat Field and Dark Current calibrations were performed.

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.

One slew was missed in revolution 190 due to a short drop in TM from the station. Another Close Loop Slew was missed in revolution 191, because the STR released the commanded star in the last (tracking) cycle of the Search-and-Track process.

The fuel consumption over the period between 30/04/2004 and 07/05/2004 was 0.166 kg. The remaining propellant is in the order of 170.793 Kg on the 7th of May.

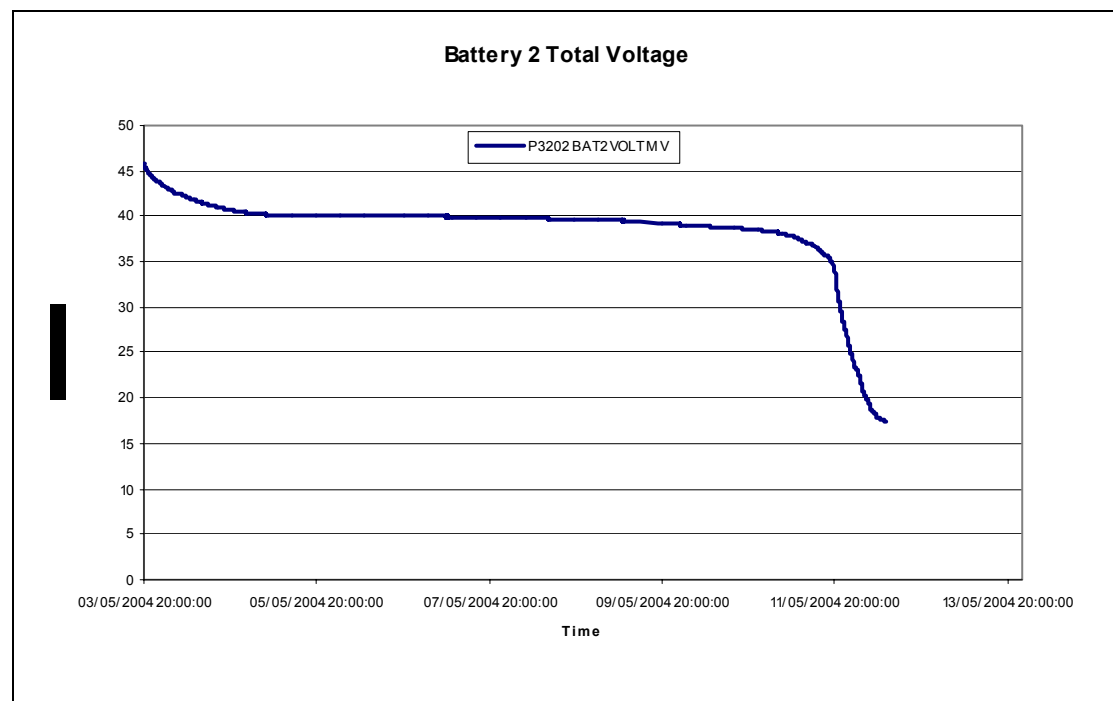
Note: Some more information concerning the AOCS operations and the fuel budget is provided in the Appendix.

3.1.2 Power

The power subsystem is working as specified. The available power from the arrays is in the order of **2200W**.

Battery 2 Reconditioning:

Battery 2 reconditioning started on 03/05/2004 at 20:10. It was discharging all week and should reach the low voltage limit on 13/05/2004 around 22:00. The following plot illustrates the discharge profile of Battery 2 Voltage so far.



The behaviour of the battery has so far been completely nominal.

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

The overall status of the instrument is nominal.

During the reporting period the instrument was in photon-by-photon mode with spectra TM enabled, an assigned TM bandwidth in the science windows of 98 pkts/cycle and an actual average occupation of 94.8 pkts/cycle (+1.2 pkts w.r.t. previous week).

The 3rd annealing of the Germanium detectors has been decided to start on 17th June at rev. 204 critical altitude descending crossing.

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 status of the unit is Nominal.

The TM bandwidth assigned to IBIS during the observation period was 134 pkts/cycle, except from 07:58:43 to 11:45:23 on DoY 125 during the OMC FF & DC calibrations, when the TM allocation was 90 pkts/cycle.

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 from 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 during normal science operations, and 63 packets/cycle during the FF and DC calibrations.

There were 190 OMC pointings executed nominally, 2 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.

The observation period was characterised by moderate solar activity.

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 good this week, well above the system performance requirements.

4.1 Mission Operations Centre

The performance of the MOC was very good in the reporting period.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There were, however, a few communication problems with both ground stations, one of which impacted the real-time distribution of science data.

A new S/W release relevant to the processor of the Goldstone station is currently been tested.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSF's: Received up to rev. 200

POS and POD generated: up to rev 200

TSF's: Received up to rev 194

One ToO request received but rejected. No re-planning this week

2. Observation status

ECS for revolution up to 180 received except 168 and 179. Corresponding OCS's sent to ISDC.

3. ISOC science archive

Nothing to report this week

4. ISOC system

The ISOC system version 10.4 has been used for the planning activities this week.

5. Problems

No problems have occurred this week.

6. ISOC move to ESAC/VILSPA

A review with Systems and hardware people from ESAC/VILSPA took place this week. Network topology proposed by VILSPA agreed. Details on schedules for hardware move from ESTEC to ESAC/VILSPA as well as details on new equipment and redeployment of existing hardware has been defined.

4.3.2 ISDC

On 10/05/2004, the status of ISDC observation processing is:

- Latest Standard Analysis completed: observation 02200350004 (GX 339-4, Revolution 166) on 06/05/2004
- Latest products archived: observation 01200470001 (NGC 4945, Revolution 149-150) on 12/03/2004
- Latest observation products sent to the observer: observation 01201250002 (Cassiopeia A, Revolution 144-148) on 19/03/2004

5 Special Events

The reconditioning of battery 2 has been started.

6 Anomalies

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

- On DoY 123 at 11:19, the status of sun121 went to yellow, with 35% of the cpu being consumed. The number of graphs, being displayed, was reduced on this workstation, restoring the status to green.
- Later, at 14:57, Network reported a problem on IFMS1, this was then switched to IFMS2, without impact
- On DoY 124, it was noted, that the off-line machines PC120 & 124, had been infected with a virus, CCC has been informed, there was no impact.
- On DoY 125 at 01:10, inctr-b, was in a yellow state, due to insufficient swap space, this was later rebooted at 08:29, without impact.
- Later, at 08:04, there was an error sending data to the isds. CCC restarted the isds & ifrd, restoring the TM flow.
- At 19:50, sun124 was in a yellow state, with CPU usage high, a few displays were closed restoring the status to green.
- At 20:25, the same thing happened to sun121, and was solved in the same way.
- On DoY 126, at 10:14, Redu handed over to DSS-16 for uplink, and DSS-24 for the downlink.
- At 10:42, there was an error sending data to the ISDC. CCC stopped and restarted the isds & ifrd restoring the link.
- From 11:14 to 11:17, the TC link from DSS-16 was lost, there was no impact. The corresponding DR# is G104363.
- From 13:08 to 13:10, the TC was taken down on DSS-16, and brought up on DSS-24, no impact.
- On DoY 127, at 08:47, the TM from DSS-16 dropped, the impact was pointing 01900089 was lost, with 01900090 recovered manually at the nominal time. The corresponding DR# is G104366.
- At 13:50, the TM from DSS-16 was lost, causing a Star TRacker mapping command to fail release, there was no further impact, as the satellite was inside the radiation belts anyway.
- At 13:51, the TC link was lost, again without significant impact. The DR# is N102144.
- At 14:00, there was another TM drop from DSS-16, causing another AOCS command to fail release, again without significant impact.
- On DoY 128 at 04:36, a guide star failed, forcing the AOCS commanding to be disabled, which led to the loss of pointing 01910012, the following pointing was recovered manually at the nominal time.

The following new anomaly reports have been entered into the Anomaly Reporting and Tracking System this week. Repeats of existing anomalies are not shown in this table.

AR id	Date Occurrence	Subject	Segment	Status
INT-2589	07/05/2004	Duplicated Frames in MADDS-B Archive	IMCS	Open

7 Future Milestones

The end of reconditioning of battery 2 is planned for 14 May.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 189

The observations in revolution 189 consisted of a GPS lasting ~13 hours followed by a raster dithering observation of the Sagittarius Arm tangent (RA 19:00:1.43; DEC +06:55:17.0), which was performed for the remaining ~48 hours of observation time.

Revolution 190

The observations in revolution 190 began with a raster dithering observation of Cygnus X (RA 21:13:12.00; DEC +41:15:58.0) performed for ~9.5 hours. This was followed by a staring observation at the OMC Flat Field target (RA 19:19:12.00; DEC +61:54:00.0) lasting ~3.5 hours, during which OMC Flat Field and Dark Current calibrations were performed. The raster dithering observation of Cygnus X was then resumed and performed for the remaining ~48 hours of observation time.

Revolution 191

The observations in revolution 191 began with a raster dithering observation of Cygnus X centred at (RA 21:13:12.00; DEC +41:15:58.0) and lasting ~45 hours. This was followed by an amalgamated raster dithering observation of the Cygnus X region centred at (RA 20:33:10.00; DEC +41:12:00.0) and encompassing observations of the Wolf-Rayet colliding wind binary systems WR140, WR146 and WR147 as well as the proto-globular cluster Cyg OB2. This observation was performed for the remaining ~16 hours of observation time.

Throughout all revolutions SPI, IBIS and JEM-X1 were in their nominal science modes and JEM-X2 was in Safe mode. During the OMC Flat Field observation, OMC was in FF Calibration and then DC Calibration modes and the TM allocation was IBIS 90; SPI 84; JEM-X1 8; JEM-X2 1; OMC 63. Apart from that, OMC was in Science Normal mode and the TM allocation was IBIS 134; SPI 98; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2004-04-21T14:49:52.000Z	171.0901	F	Automatic TM processing.
2004-04-21T21:04:01.000Z	171.0741	F	Automatic TM processing.

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2004-04-23T06:57:08.000Z	171.0309	F	Automatic TM processing.
2004-04-24T10:21:35.000Z	171.0083	F	Automatic TM processing.
2004-04-24T20:49:12.000Z	171.0062	F	Automatic TM processing.
2004-04-26T06:53:24.000Z	170.9939	F	Automatic TM processing.
2004-04-27T14:24:55.000Z	170.9807	F	Automatic TM processing.
2004-04-27T20:36:16.000Z	170.9595	F	Automatic TM processing.
2004-04-30T14:11:03.000Z	170.9434	F	Automatic TM processing.
2004-04-30T20:16:39.000Z	170.8804	F	Automatic TM processing.
2004-05-02T06:30:59.000Z	170.8632	F	Automatic TM processing.
2004-05-03T13:43:26.000Z	170.8513	F	Automatic TM processing.
2004-05-03T20:00:31.000Z	170.8370	F	Automatic TM processing.
2004-05-06T13:44:45.000Z	170.8123	F	Automatic TM processing.
2004-05-06T19:45:02.000Z	170.7931	F	Automatic TM processing.

This report was generated Fri May 7 08:00:26 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 Operations

AOCS operations were executed from the Automatic Timeline.

During this period, 31 Open Loop Slews, 167 Closed Loop Slews and 5 Momentum Bias were executed. 2 slews were missed or executed manually. This is equivalent to a 1.0%.

01/05/04 (Day of Year 122, Revolution 189)

Nothing to report.

02/05/04 (Day of Year 123, Revolution 189)

Nothing to report.

03/05/04 (Day of Year 124, Revolution 189-190)

Nothing to report.

04/05/04 (Day of Year 125, Revolution 190)

Nothing to report.

05/05/04 (Day of Year 126, Revolution 190)

Nothing to report.

06/05/04 (Day of Year 127, Revolution 190-191)

Slew missed due to a short TM drop from the station (Goldstone, DSS=16): A short drop of TM from the ground station at 08:47 interrupted the sequence for slew 01900089 and resulted in the missing of the slew. After re-establishment of the link, a manual Open Loop Slew was performed to the attitude of PID 01890090. PID 01890089 was affected.

07/05/04 (Day of Year 128, Revolution 191)

Close Loop Slew 01910012 failed execution because the STR did not pick the commanded star: The STR Search-and-Track sequence failed to pick the commanded star for close loop slew 01910012, resulting in the loss of the slew. The star was 2713-00151 with instrumental magnitude 7.74 and spectral type K0. The STR did not report this star during the mapping based on which it was selected for the slew. However, it was reported in slot #2 in the searching and gain selection cycles of the Search-and-Track process, but released in the last cycle (tracking). There is no close-by neighbor to this star and it is not clear why it was released during the tracking cycle of the Search-and-Track. If more problems with this specific star are also observed in the future, then it should be decided to exclude it from the catalogue in the FD system. To rejoin the Timeline, a manual Open loop slew was performed to the attitude of PID 01910013.

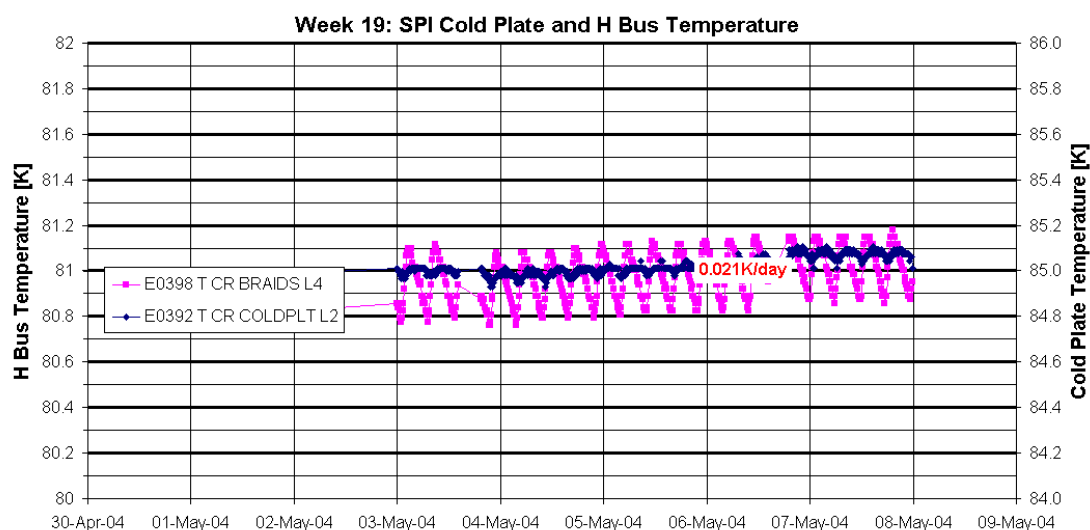
8.3.2 SPI Operations

Cryo-cooler / Detector Cold-Plate:

The performance of the cryo-cooler is nominal.

The cold plate temperature is leveled off at around 81K with a small positive drift of 0.021K/day, which is within the expected range.

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

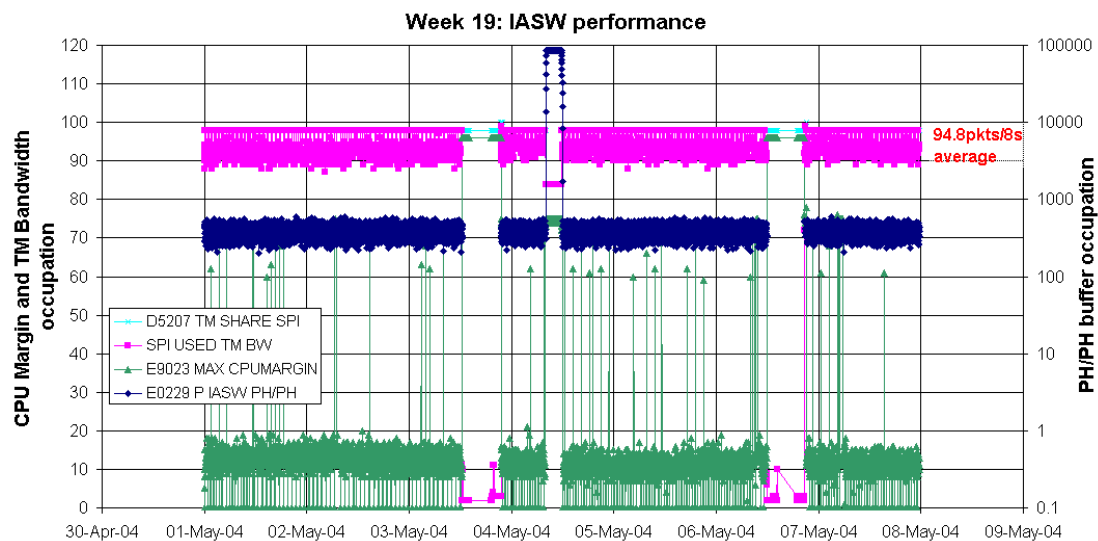


IASW/DPE:

The performance of the IASW/DPE is nominal. The average TM bandwidth occupation was 94.8 pkts/cycle in the science windows (+1.2pkts w.r.t. previous week).

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

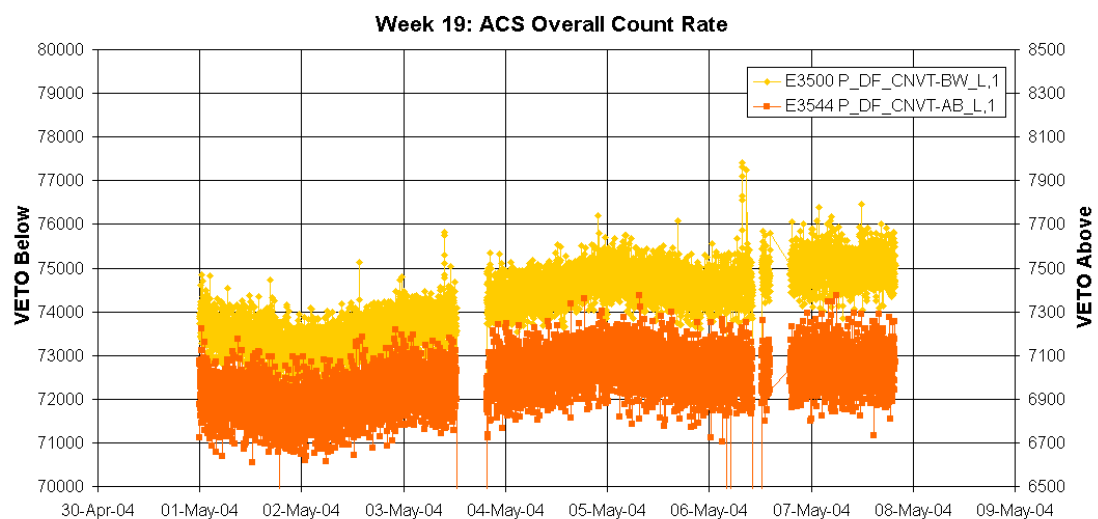
The peak on the photon buffer occupation is a saturation of the buffer corresponding to and OMC Dark Current/Flat Field Calibration, taken place in revolution 190, from 2004-05-04T07:58:43Z to 2004-05-04T11:45:23Z. During the calibration the SPI TM allocation was in fact reduced. The TM Allocation was IBIS 90; SPI 84; JEM-X1 8; JEM-X2 1; OMC 63.



ACS:

The performance of the ACS is nominal.

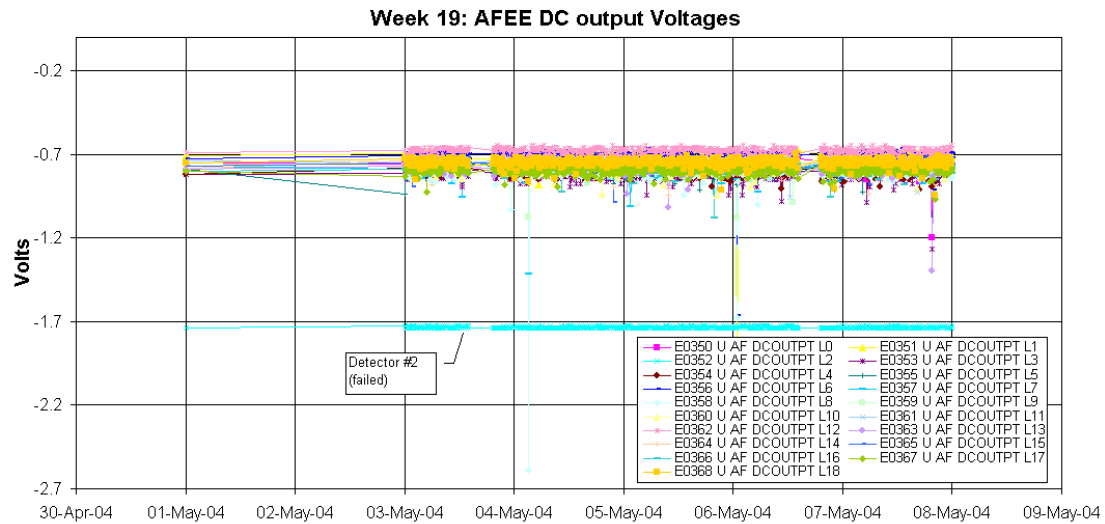
The following plot shows the ACS overall count rate evolution (Veto below / above ~100MeV counts) during the reporting period.



AFEE:

The performance of the detectors is nominal except for the detector #2 failed since 06.12.2003 (see anomaly report INT_SC-72).

The AFEE dc output signals are here after plotted during the reporting period.



DFEE:

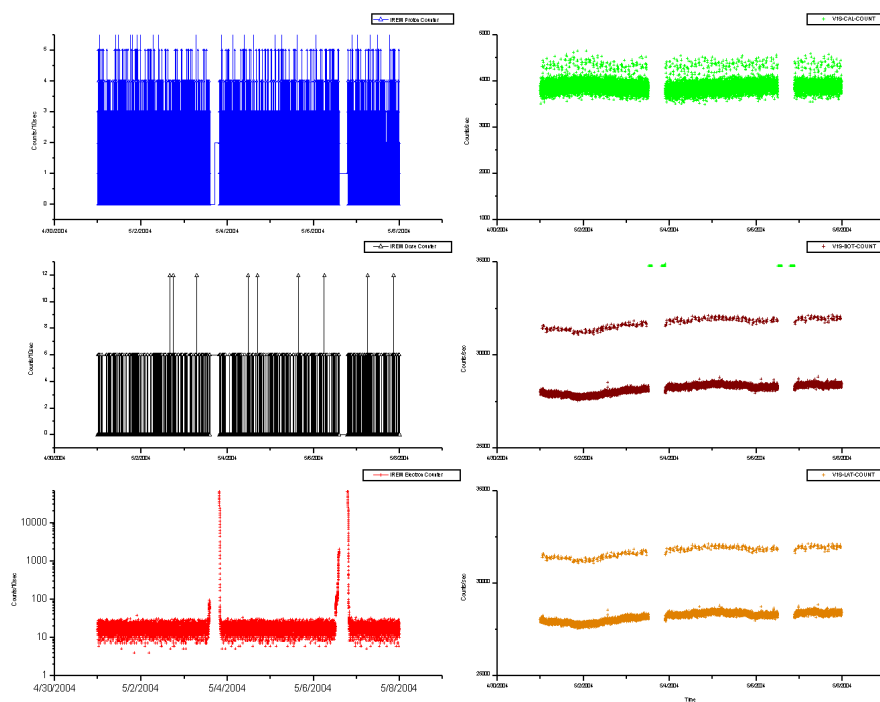
The following plot shows the GeD Non Vetoed event rates processed by the DFEE during the reporting period. The count rate of each detector is within the expected range, except for the failed detector #2.

8.3.3 IBIS Operations

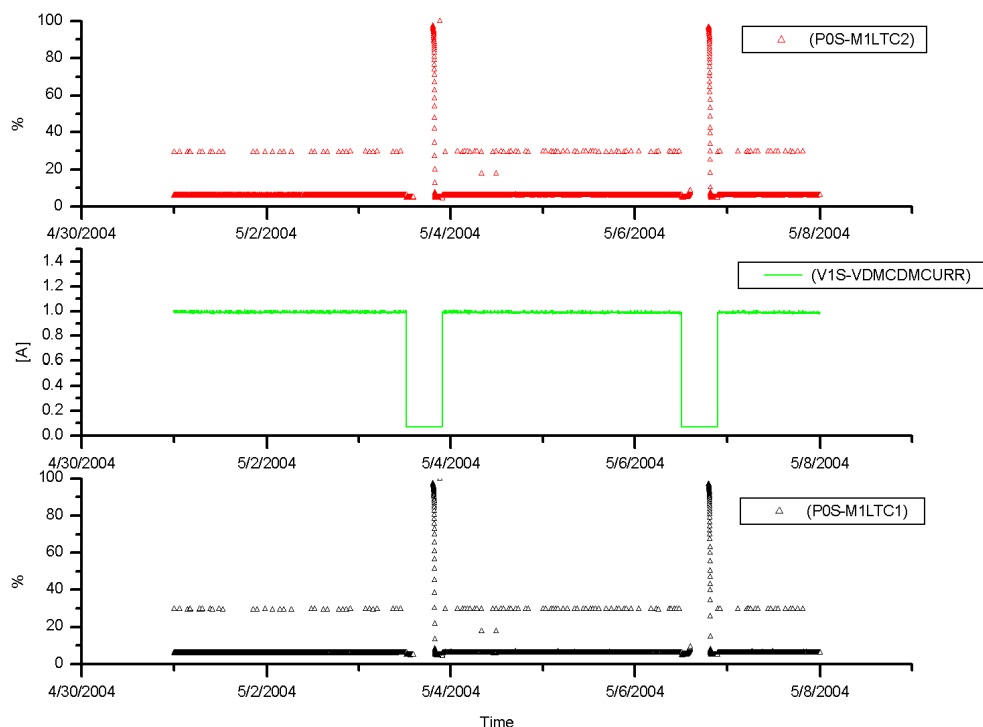
IBIS event counters plot

Plots of the reported VETO VDM/CDM current, the VETO bottom-lateral-calibration counters, the PICsIT PDM#1 SM1-2 dead times are shown below:

IBIS-VETO Counters Rev 189-190

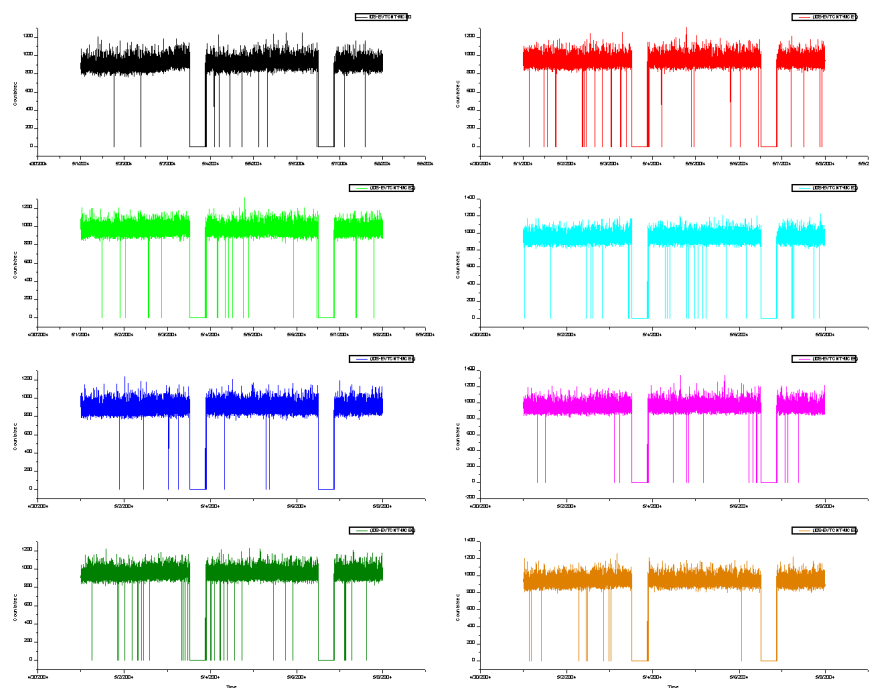


IBIS VETO VDM Current & PICsIT dead time

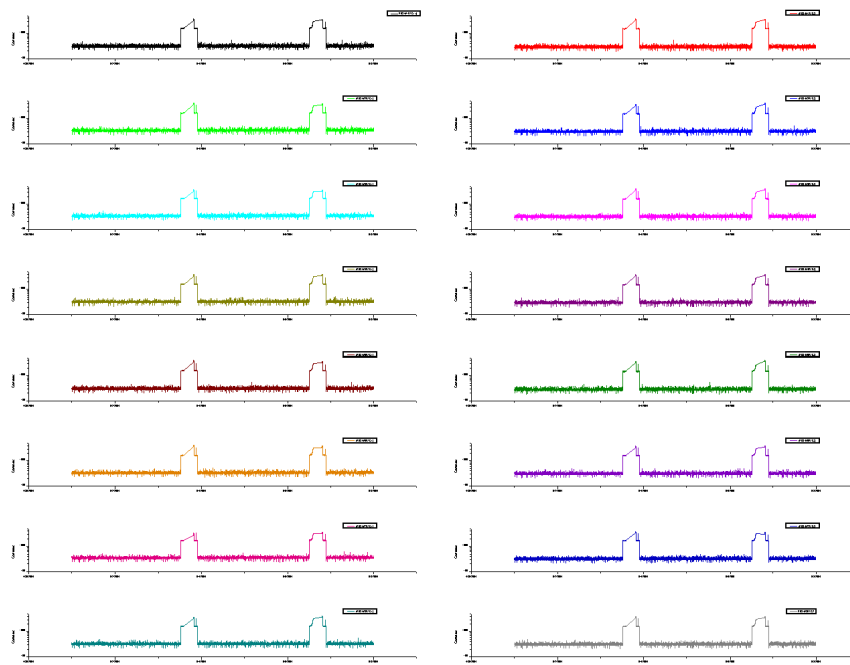


Plots of the ISGRI and PICsIT counters, during the observation period, are shown below:

ISGRI Counters Rev 189-190



IBIS-PICsIT Counters Rev 189-190



Nothing to report

DOY 2004.123 (02/05/04)

Nothing to report

DOY 2004.124 (03/05/04)

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.

DOY 2004.125 (04/05/04)

Nothing to report

DOY 2004.126 (05/05/04)

Nothing to report

DOY 2004.127 (06/05/04)

At 13:02Z a periodic dump of the on-board Peripherals Context tables (as for INT OR-87) was executed. A comparison showed no differences with respect to the master tables stored on ground.

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.

DOY 2004.128 (07/05/04)

Nothing to report

8.3.4 JEM-X Operations

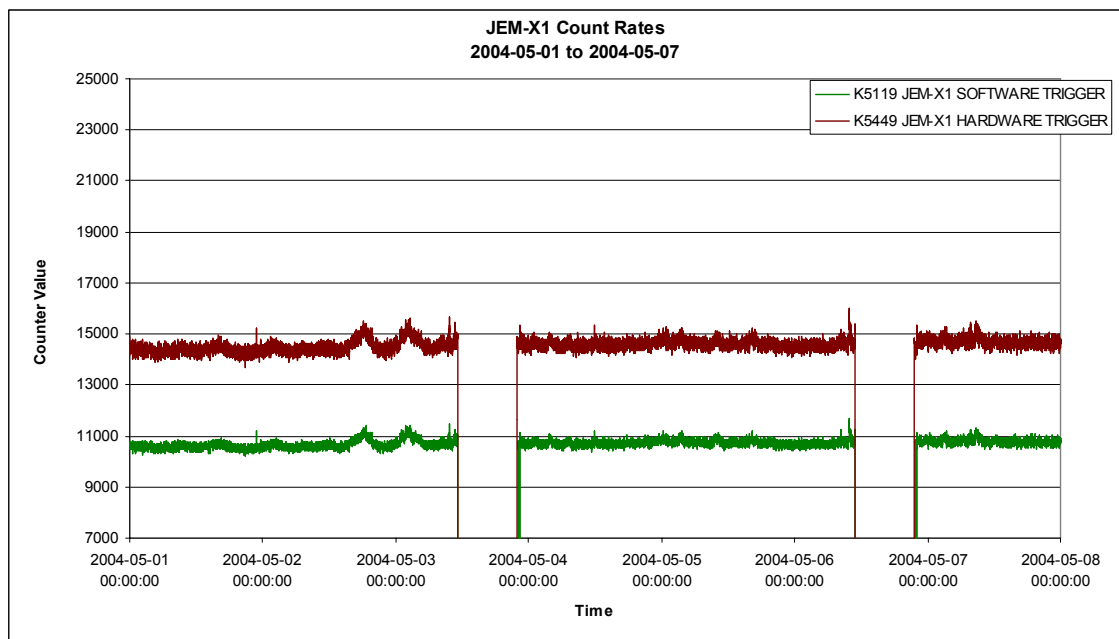
2004-05-01 (DOY 122, Rev 189) to 2004-05-07 (DOY 128, Rev 191)

Nothing to report.

8.3.4.1 JEM-X Count Rates

JEM-X1 count rates over the reporting period are displayed in the following graph¹.

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



8.3.5 OMC Operations

On DoY 125, at 07:59:37, during revolution 190, the OMC Flat Field Calibration started, the calibration terminated nominally at 10:46:33. At 10:49:52 the Dark Current Calibration commenced, which continued until 11:05:21, terminating nominally.

On DoY 127, at 08:47, due to a brief TM drop from DSS-16 slew 01900089 was missed, it was at this time that the following pairs of commands were rejected:

```
2004.127.08.54.24.549 2004.127.08.54.18.275 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=710
2004.127.08.54.16.527 2004.127.08.54.12.275 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=709
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for that pointing.

On DoY 128, at 04:36, due to an AOCS problem with guide stars, slews 01910012 was missed, and 01910013 executed manually at the nominal time, it was at this time that the following pairs of commands were rejected:

```
2004.128.04.39.44.988 2004.128.04.39.35.063 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=60,IM A M9068=1 FIX2=0 M9069=788
2004.128.04.39.37.639 2004.128.04.39.29.313 1792 Real Time Rejection 131
REJECTED TC1
FIX2=0 M5010=6,NORMAL M9079=3 M9080=131 M5001=130,RESET IM M9068=1 FIX2=0
M9069=787
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 01910012.

On DoY 124 at 12:30:33, and DoY 127 at 12:13:48, OMC was switched by the Timeline to SAFE mode, at the nominal times.

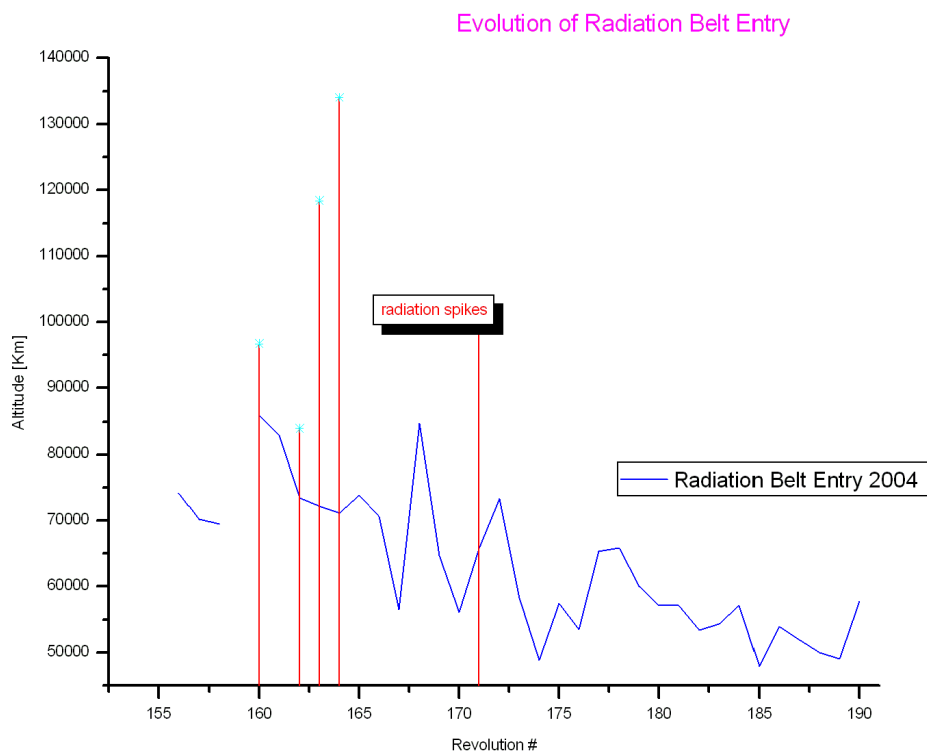
8.3.6 IREM Operations

IREM daily report

Nothing to report.

Radiation Belt Entry Analysis

The evolution of the Radiation Belt Entry in 2004, since rev 156 is reported in the following plot (the plot has been reviewed respect to the last issue, the radiation spikes are now displayed as independent event).



The Radiation Belt Entry is determined by the electron cut-off threshold (see definition below) based on JEM-X on-board radiation automatism.

The reported Electron Belts Entry/Exit for revs 189-->190, as defined by a cut-off flux of $3.76E+02$ e/cm²/sec ($E > 0.5$ MeV) and the predicted Proton Belts Entry/Exit, as defined by a cut-off flux of $1.25E+03$ p/cm²/sec ($E > 8$ MeV) are shown below:

Electron Belts

REV	S/C BCPKT (electron)	Electron CUT-	Observed	Electron CUT-OFF	Predict
-----	----------------------	---------------	----------	------------------	---------

		OFF Observed Entry/Exit	Entry/Exit Altitude [Km]	Predicted Entry/Exit	ed Entry/ Exit Altitud e [Km]
189	RAD_ENTR R 2004-05-03T12:29	03/05/2004 13:54	49050	03-May-2004 13:10	54239
190	RAD_EXIT R 2004-05-03T21:32	03/05/2004 19:55	23124	03-May-2004 20:10	26768
190	RAD_ENTR R 2004-05-06T12:13	06/05/2004 12:27	57769	06-May-2004 12:57	54139
191	RAD_EXIT R 2004-05-06T21:17	06/05/2004 19:48	24842	06-May-2004 19:57	26794

Reference

Small error vs reference

Large error vs reference

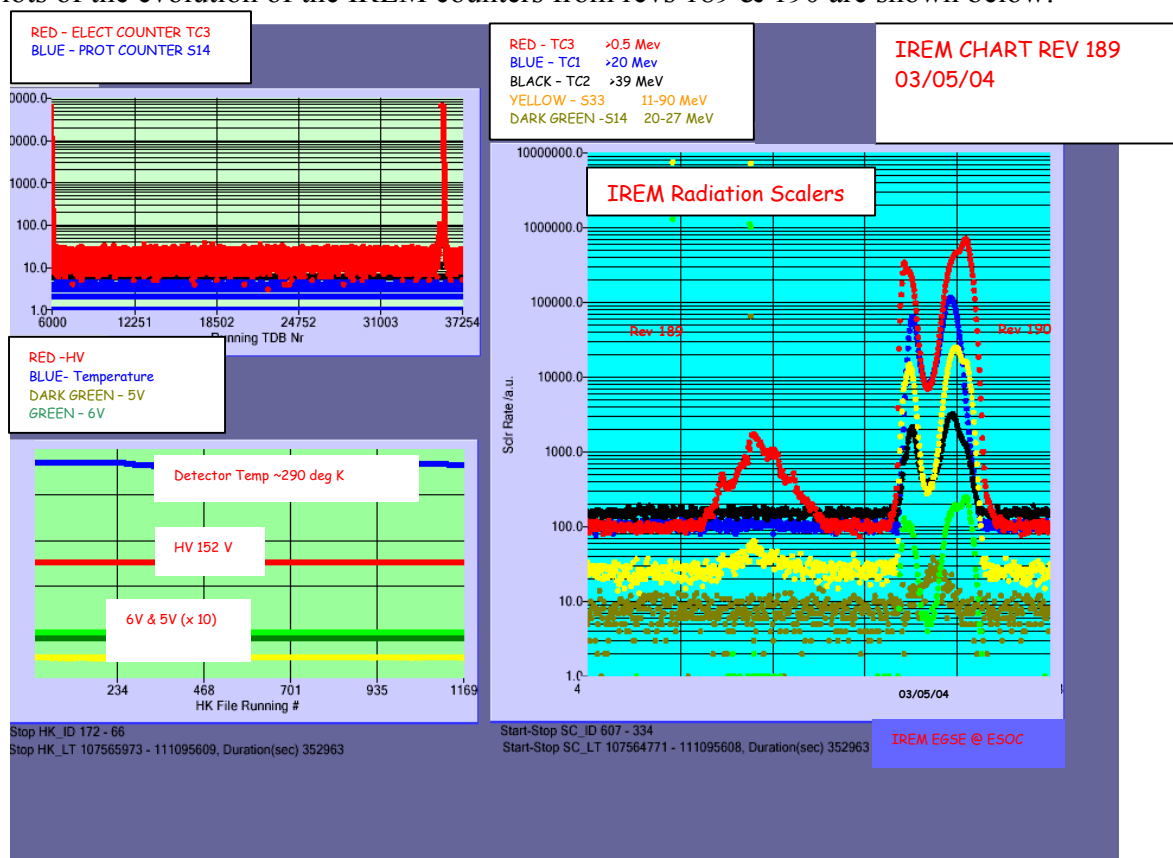
Radiation Spike

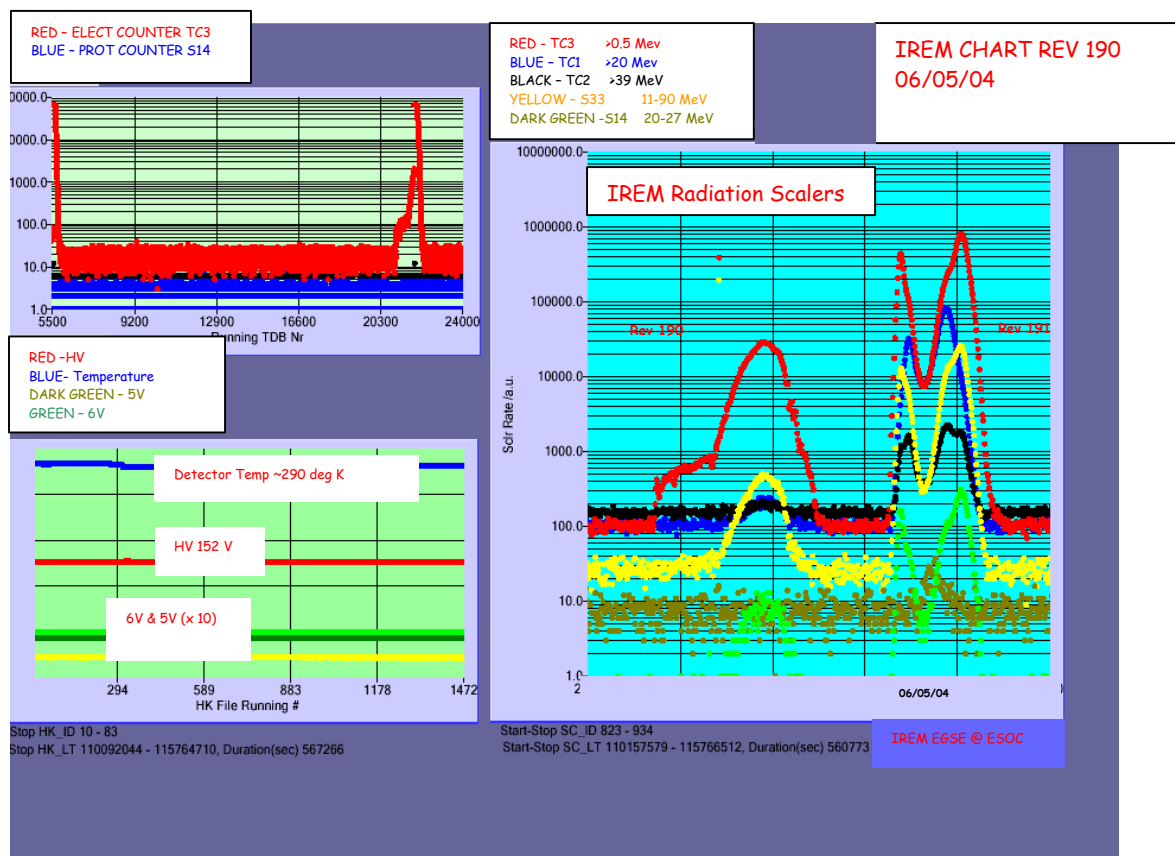
Proton Belts

REV	S/C BCPKT (proton)	Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
189	PROTON_RAD_ENTR	03-May-2004 18:30	11880
189	PROTON_RAD_EXIT	03-May-2004 19:00	15262
190	PROTON_RAD_ENTR	06-May-2004 18:17	12015
190	PROTON_RAD_EXIT	06-May-2004 18:47	15365

IREM radiation counters plot

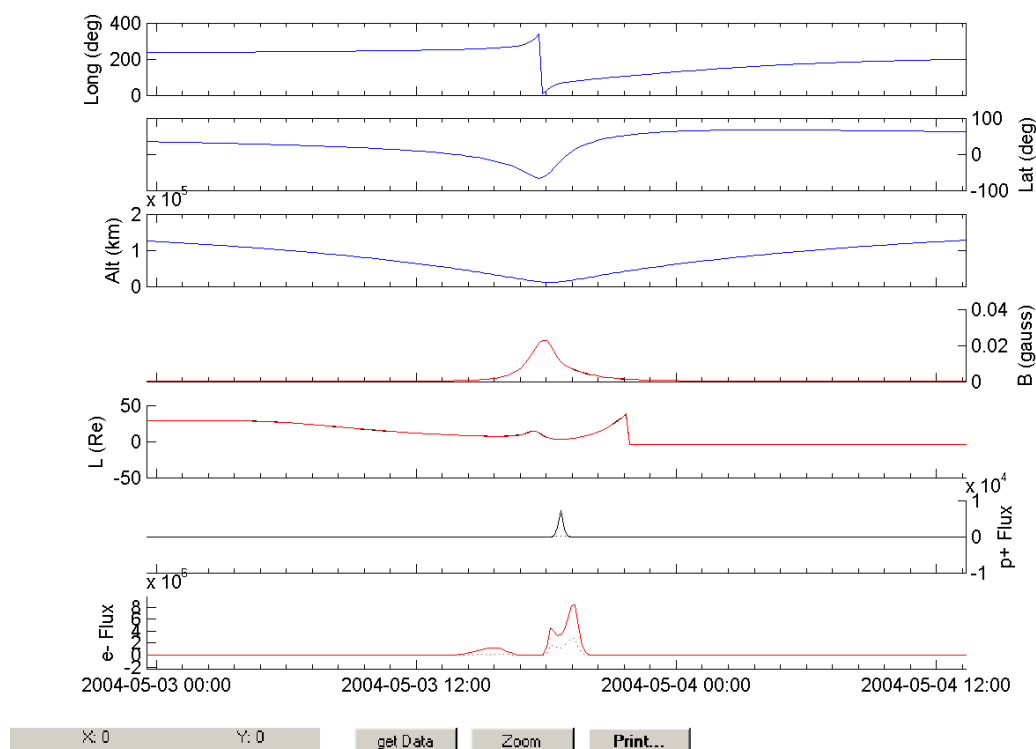
Plots of the evolution of the IREM counters from revs 189 & 190 are shown below:

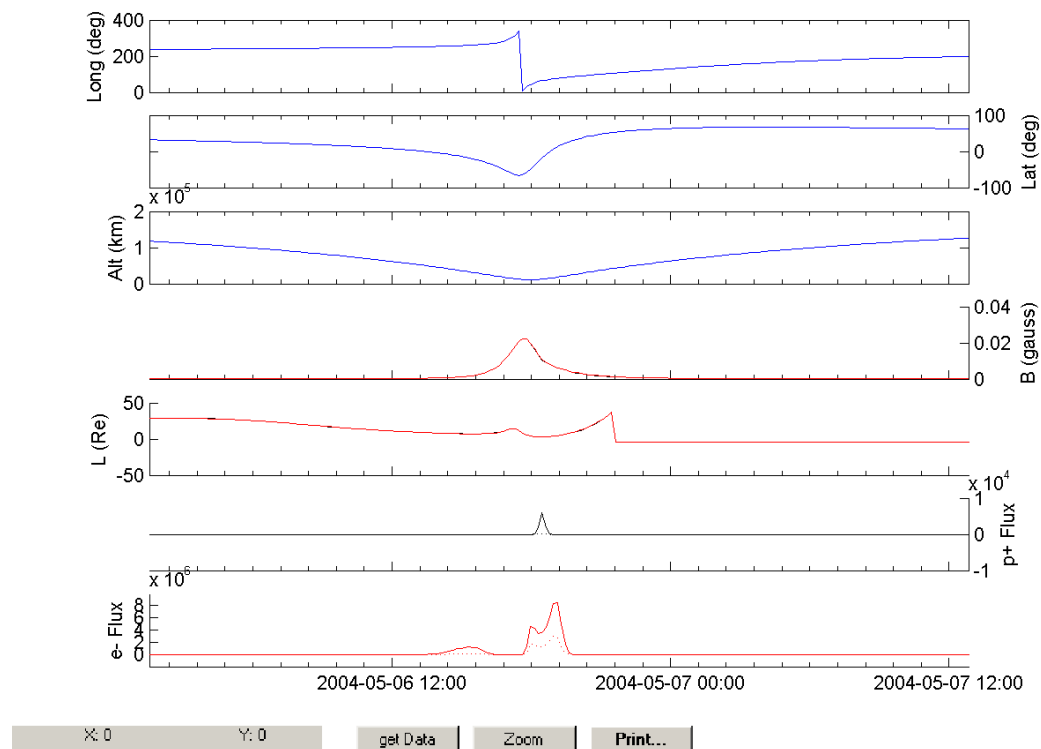




IREM predicted radiation counters

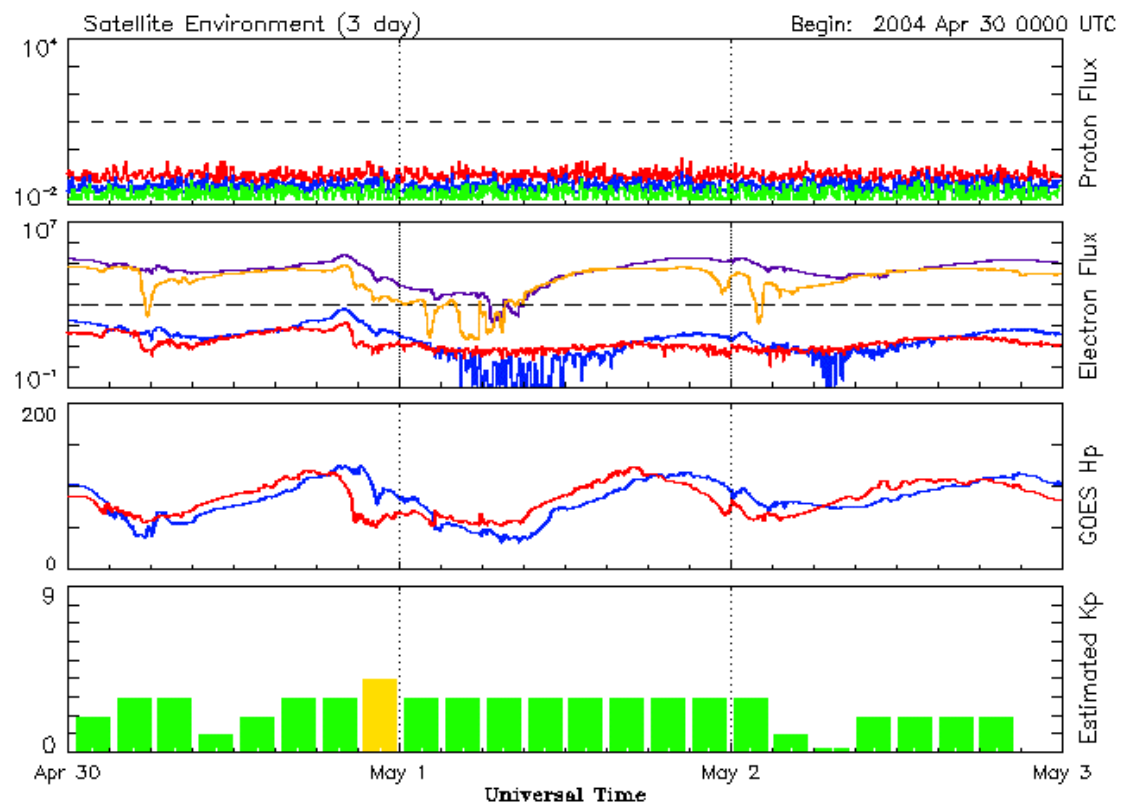
The predicted Belts passages, as calculated with AP8Max and AE8Max models (by using the RADMON tool) are:

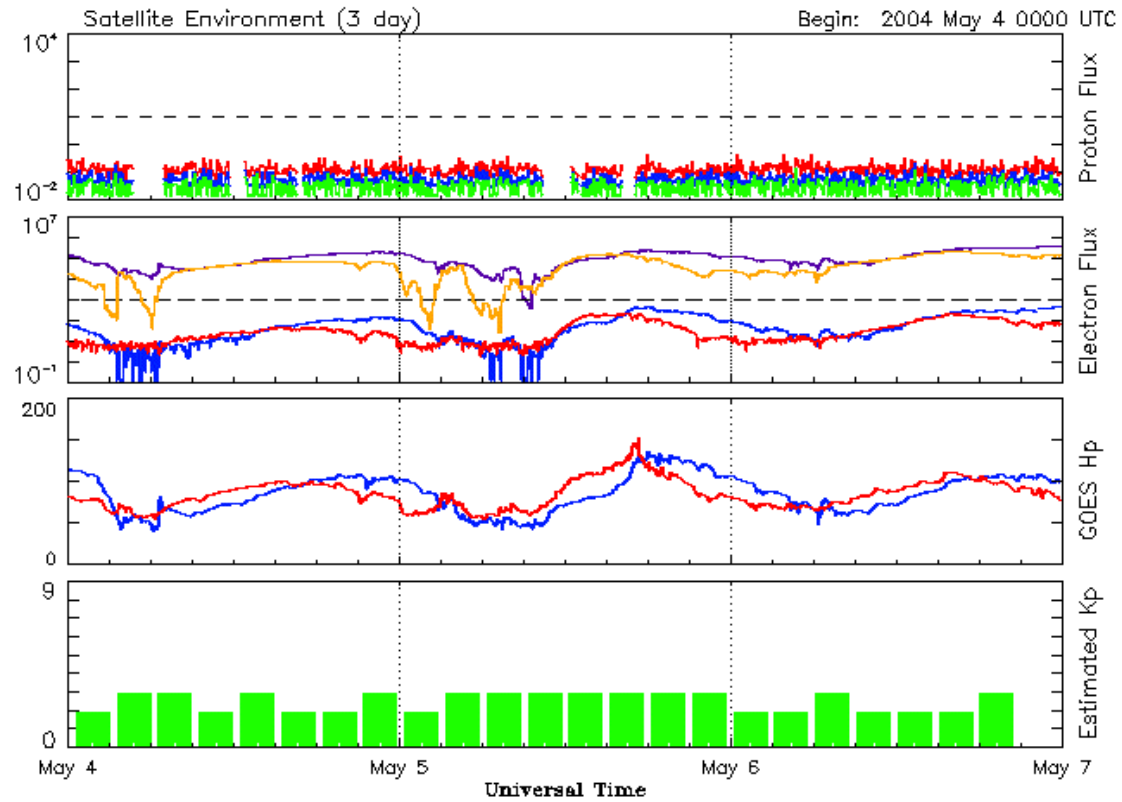




SEC-GOES observed particles fluxes

The observed proton and electron Fluxes, as reported from GOES satellites for the same period, are:





Updated 2004 May 6 23:56:09 UTC

NOAA/SEC Boulder, CO USA