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

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-TOS-OF
No. 083
Week 17
26.04.04
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 17.03.04 until 23.04.04 (both dates inclusive) and covers the revolutions 185 & 186.

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 Galactic Plane, the Galactic Center and the Sagittarius Arm tangent (RA 19:00:1.43; DEC +06:55:17.0). The activities consisted of GPS, GCDE 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.

Undetected False Events on the STR caused the flickering of the OTF in three occasions during revolution 185. None of the cases were seen at BCP level.

Two slews were lost in revolution 185 because the STR could not pick the commanded Guide Star prior to a Close Loop Slew. It was not immediately clear what the reason for this was, but FD is looking into the case.

The fuel consumption over the period between 16/04/2004 and 23/04/2004 was 0.149 kg. The remaining propellant is in the order of 171.031 Kg on the 23rd of April.

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**.

The battery reconditioning of battery 1 is progressing as foreseen.

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 92.4 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 status of the unit is Nominal.

The TM bandwidth assigned to IBIS during the observation period was 134 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.

There were 179 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 low 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 good in the reporting period, with just a few assorted minor problems, which had no impact on the execution of the Timeline.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week. There were minor problems relating to Redu, with minor impact.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSF's: Received up to rev. 192 (no change)

POS and POD generated: up to rev 192 (no change)

TSF's: Received up to rev 189

No ToO requests received. Replanned revolutions 187 to 189. The reason is import of the new IODB with ED's for JEM-X High Voltage control from ISOC included.

2. Observation status

ECS for revolution 169 received. Then ECS's up to revolution 170 except 168 are available. Corresponding OCS's sent to ISDC. This is no change since last two weeks.

3. ISOC science archive

No new data tape received. The version 1 of ESA browser is now becoming available to the internal users of the science archive. It is intended to be demonstrated to the ISDC. A URD for the next version is prepared and will be discussed in a couple of weeks with the development team in VILSPA.

4. ISOC system

The ISOC system version 10.3 has been in use this week. A patch was introduced to overcome a minor problem related to IODB import.

5. Problems

No problems have occurred this week. The investigation of the problem of last week with wrong JEM-X configuration is still not concluded.

6. ISOC move to VILSPA

There is some progress in the area of staff and support after the move. For software maintenance a solution is found. Contractual work is initiated. It has been agreed with RSSD management to issue two vacancy notices for scientists in ISOC. They are now with Personnel for further processing.

4.3.2 ISDC

On 26/04/2004, the status of ISDC observation processing is:

- Latest Standard Analysis completed: observation 01200360001 (GRO J0332-87, Revolution 152-154) on 12/04/2004
- 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 1 was started on 21 April as foreseen. The progress was as expected.

6 Anomalies

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

- On DoY 110 at 04:55, sun124 was showing yellow, with the Telemetry monitor using excessive CPU, this task was stopped and started, curing the problem.
- Later, at 09:40, the isds was re-booted as a first step towards curing an on-going TDRS problem.
- At 10:31, the idda was yellow and giving a warning that it could not send data request to the cache, unix error 32.
- At 22:25, the iddb was yellow, indicating free disk space was down to 94066K.
- On DoY 111, at 10:31, 2 bad VC0 TM frames were received from Redu, which coincided with Reed Solomon alarms.
- At 19:20, an AOCS command failed release due to dynamic PTV failure. The AOCS commanding was then disabled. The impact was slews 01850076 and 01850077 were missed.
- On DoY 113, at 05:06, a hit on the line to Redu, caused the TM & TC lines to drop, the TM line returned at 05:08, and the TC at 05:11. There was no impact.
- At 07:54, the TC link was taken down for a test, at 07:57, the TC was up in Redu, and a Star Tracker mapping performed. At 08:07 the test was terminated and the links restored at the MOC at 08:07. There was no impact.
- At 13:45 the idda status was red. The TMD-B on MSADDS-B were restarted curing the problem.
- At 20:20, the TMPs at Redu were stopped and re-started (INT-OR-0067).

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- On DoY 114, at 05:23, NCTRS-A was restarted causing the links to drop. The TM link was back at 05:25, and the TC at 05:27, there was no impact.

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-2583	19/04/2004	TDRS: packet Retrieval Option Lost	IMCS	Open
INT-2584	21/04/2004	Incorrect Dates put on OBSM displays/printouts	IMCS	Open

7 Future Milestones

The end of the discharge of the battery 1 reconditioning is envisaged in the period from 01 to 03 May. The recharge will start immediately afterwards. After an assessment of the performance of the battery 1 reconditioning the reconditioning of batter 2 will be started.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 185

The observations in revolution 185 consisted of a GPS lasting ~17 hours, followed by a GCDE, which was performed for the remaining ~44 hours of observation time.

Revolution 186

The observations in revolution 186 consisted of a raster dithering observation of the Sagittarius Arm tangent (RA 19:00:1.43; DEC +06:55:17.0) lasting ~17 hours, followed by a GCDE lasting ~33 hours and finally a GPS, which was performed for the remaining ~9 hours of observation time.

Throughout these revolutions all instruments were in their nominal science modes, except for JEM-X2, which was in Safe 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

2004-04-06T22:14:43.000Z	171.3640	F	Automatic TM processing.
2004-04-07T07:00:44.000Z	171.3230	F	Automatic TM processing.
2004-04-09T11:35:05.000Z	171.3037	F	Automatic TM processing.
2004-04-09T15:24:10.000Z	171.2811	F	Automatic TM processing.
2004-04-09T21:58:03.000Z	171.2720	F	Automatic TM processing.
2004-04-11T08:35:50.000Z	171.2373	F	Automatic TM processing.
2004-04-12T21:36:50.000Z	171.2235	F	Automatic TM processing.
2004-04-15T21:28:41.000Z	171.1796	F	Automatic TM processing.
2004-04-17T07:15:49.000Z	171.1691	F	Automatic TM processing.
2004-04-18T15:00:48.000Z	171.1460	F	Automatic TM processing.
2004-04-18T21:13:36.000Z	171.1315	F	Automatic TM processing.
2004-04-19T05:46:41.000Z	171.1080	F	Automatic TM processing.
2004-04-21T14:49:52.000Z	171.0901	F	Automatic TM processing.
2004-04-21T21:04:01.000Z	171.0741	F	Automatic TM processing.
2004-04-23T06:57:08.000Z	171.0309	F	Automatic TM processing.

This report was generated Fri Apr 23 08:00:16 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, 103 Open Loop Slews, 86 Closed Loop Slews and 7 Momentum Bias were executed. 2 slews were missed or executed manually. This is equivalent to a 1.06%.

17/04/04 (Day of Year 108, Revolution 184)

Nothing to report.

18/04/04 (Day of Year 109, Revolution 184-185)

Nothing to report.

19/04/04 (Day of Year 110, Revolution 185)

Flickering of the Pointing-Bit due to undetected False Events on the STR: At 07:35:15, an undetected False Event on the STR caused a jump of [160, 60] CCD units in the coordinates of the Guide Star. The error in Y was more than the OTF threshold for Pitch. This caused the flickering of the Pointing-Bit, which was not seen at BCP level. The 8.4 Mi Guide star was selected by the ACC after an Open Loop Slew and was located at [-14206, 12241]. The altitude was about 100400 km.

Flickering of the Pointing-Bit due to undetected False Events on the STR: At 13:43:46, an undetected False Event on the STR caused a jump of [346, 99] CCD units in the coordinates of the Guide Star. The error in Y was more than the OTF threshold for Pitch. This caused the flickering of the Pointing-Bit, which was not seen at BCP level. The 8.25 Mi Guide star was selected by the ACC after an Open Loop Slew and was located at [-11263, 12081]. The altitude was about 125000 km.

20/04/04 (Day of Year 111, Revolution 185)

Flickering of the Pointing-Bit due to undetected False Events on the STR: At 10:52:10, an undetected False Event on the STR caused a jump of [519, 457] CCD units in the coordinates of the Guide Star. The errors in Y and Z were both more than the OTF thresholds for Pitch and Yaw. This caused the flickering of the Pointing-Bit, which was not seen at BCP level. The 8.3 Mi Guide star was selected by the ACC after an Open Loop Slew and was located at [555, 5986]. The altitude was about 150700 km.

Slews missed because the STR did not pick the commanded Guide Star during the Search-and-Track: The FDS selected star 6887-01977 (Spectral Type: K2) for the Close Loop Slew 01850076. This star was seen by the STR in two mappings with magnitude 7.7 and at CCD locations [-9297, -16215] and [-9300, -16213], both on pixel [250, 43]. The STR, however, did not pick this star during the Search-and-Track that was commanded before the slew and the execution of the slew was interrupted. It was not immediately clear why the STR did not pick this star, but Flight Dynamics is looking into this case. Slew 01850076 was missed and then a manual Open Loop Slew was performed to the attitude of PID 01850077. PIDs 76 and 77 were lost.

21/04/04 (Day of Year 112, Revolution 185-186)

Nothing to report.

22/04/04 (Day of Year 113, Revolution 186)

Nothing to report.

23/04/04 (Day of Year 114, Revolution 186)

Nothing to report.

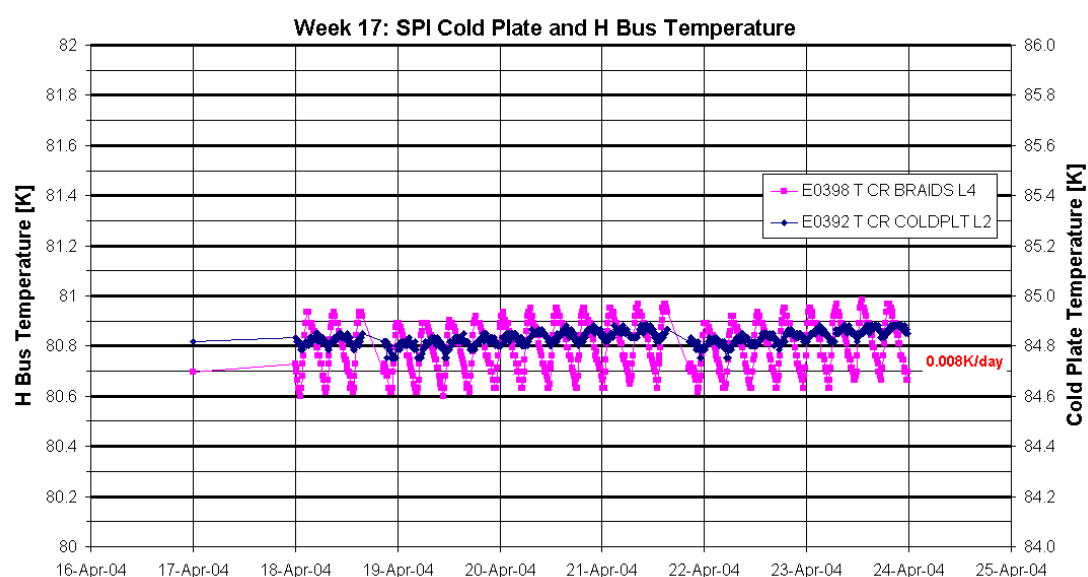
8.3.2 SPI Operations

Cryocooler / Detector Cold-Plate:

The performance of the cryocooler is nominal.

The cold plate temperature is leveled off at around 80.7K with a small positive drift of 0.008K/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 95.5 pkts/cycle in the science windows (+0.4pkts w.r.t. previous week).

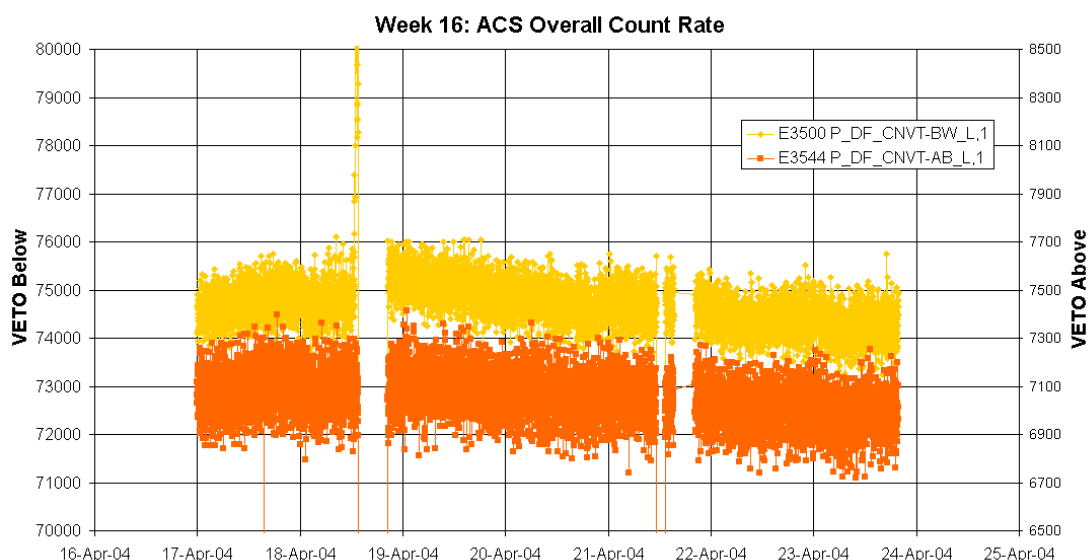
The following diagram shows the IASW performance in terms of TM bandwidth and event buffer occupation during the reporting period:



ACS:

The performance of the ACS is nominal.

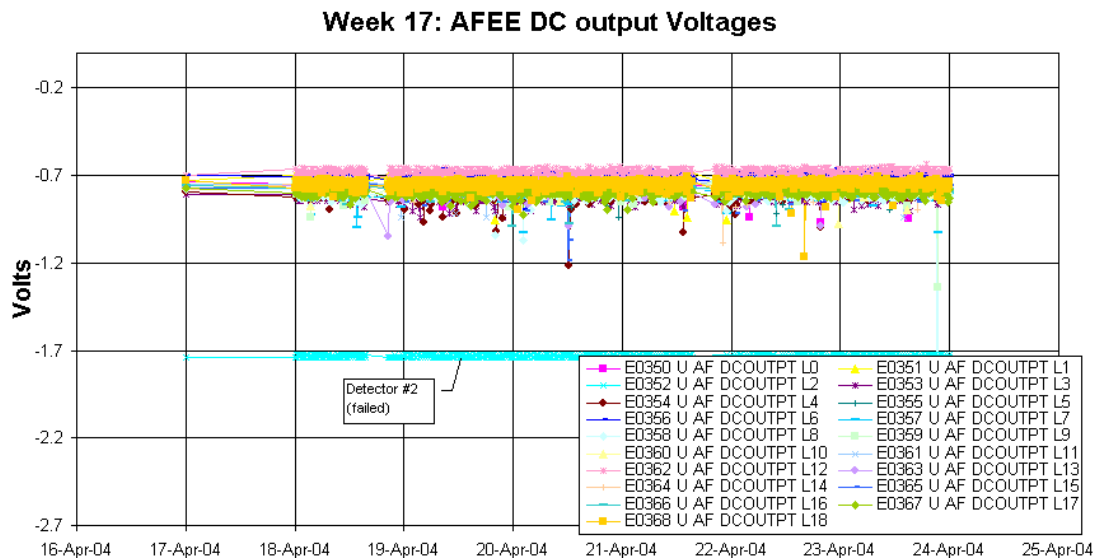
The following plot shows the ACS overall count rate evolution (Veto below / above ~100MeV counts) during the reporting period.



AFEE:

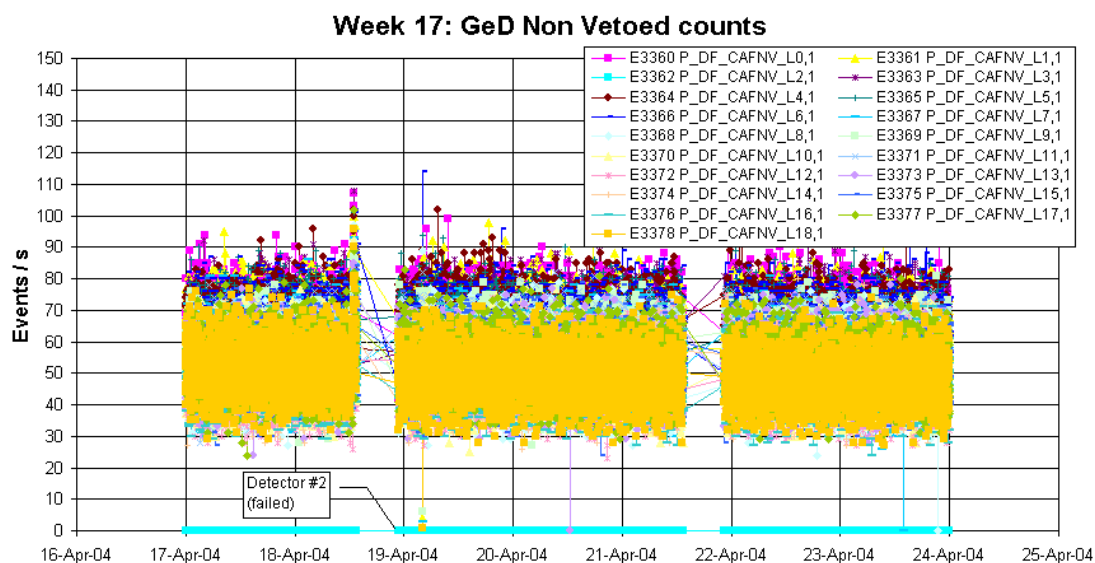
The performance of the detectors is nominal except for the detector #2 failed since 06.12.2003 (see anomaly report INT_SC-72).

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.



PSD:

The performance of the unit is nominal.
 Nothing to report.

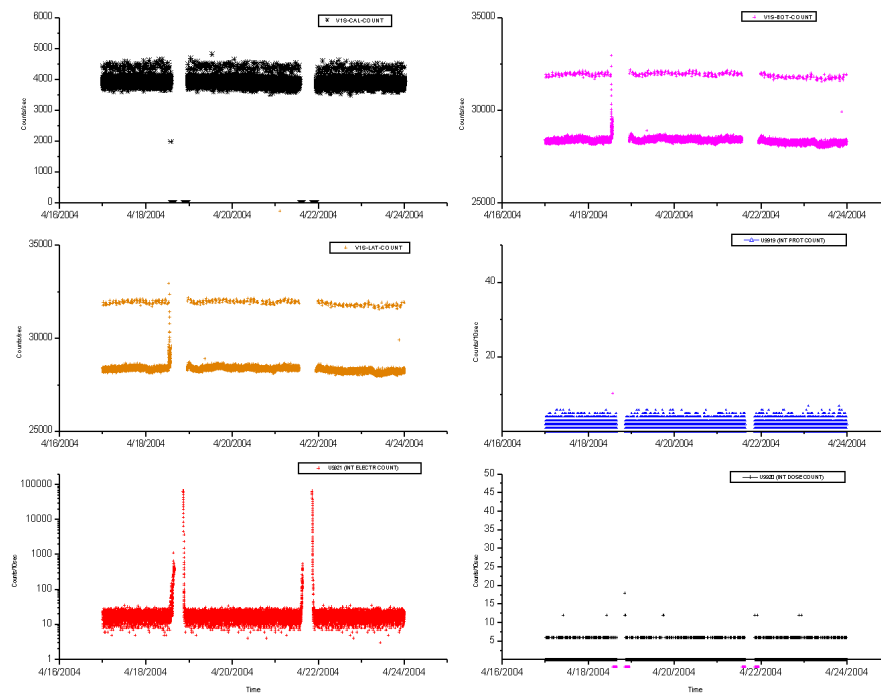
8.3.3 IBIS Operations

IBIS event counters plot

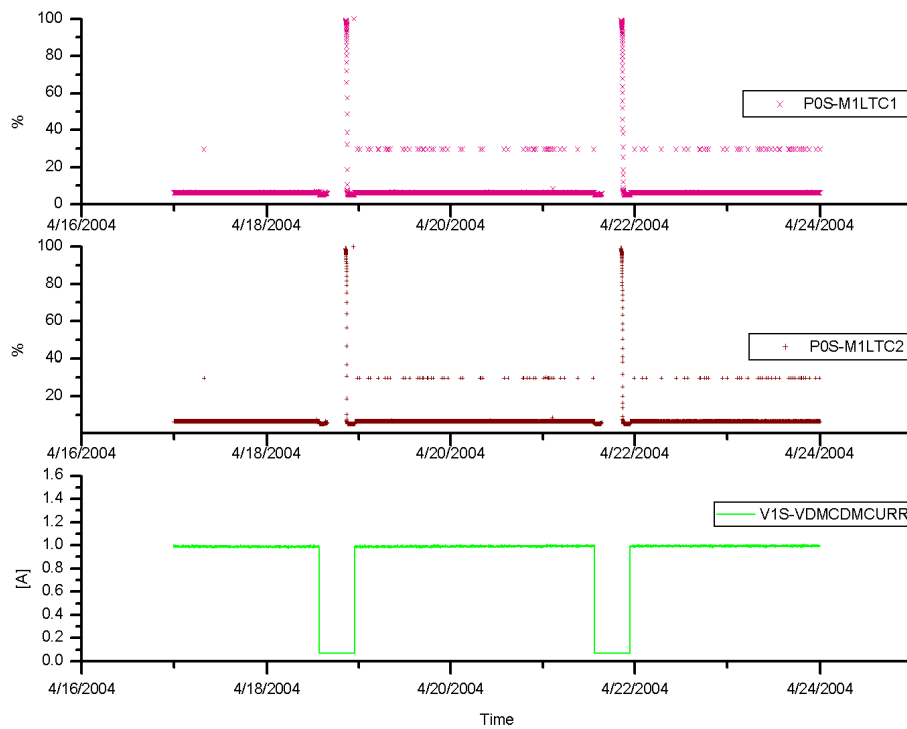
Plots of the reported VETO VDM/CDM current, the VETO bottom-lateral-calibration counters, the PICsIT PDM#1 SM1-2 dead times are shown

below:

IBIS-VETO COUNTERS REV 184-186

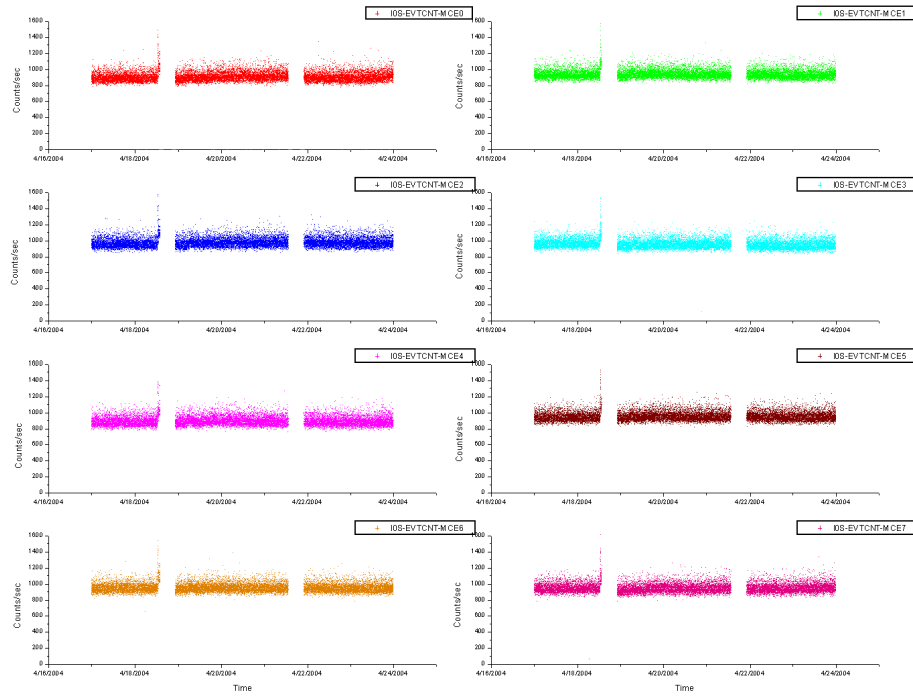


IBIS-VETO VDM CURRENT REV 184-186

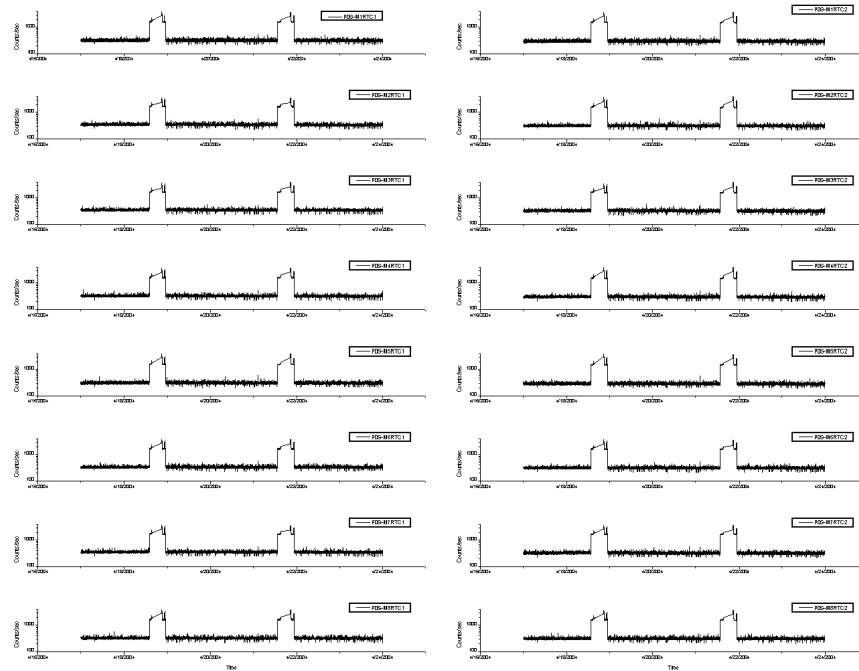


Plots of the ISGRI and PICsIT counters, during the observation period, are shown below:

IBIS-ISGRI COUNTERS REV 184-186



IBIS-PICsIT COUNTERS REV 184-186



IBIS daily report

DOY 2004.108 (17/04/04)

Nothing to report.

DOY 2004.109 (18/04/04)

Nothing to report

DOY 2004.110 (19/04/04)

Nothing to report.

DOY 2004.111 (20/04/04)

Nothing to report.

DOY 2004.112 (21/04/04)

At 12:42Z the TM parameter G2000(IOE-OVFWPXADD-M0) failed SCC: the reason was the overflow in the number of the noisy pixel detected for ISGRI detector module 0. The condition was cleared 1 minute later and no action was taken.

DOY 2004.113 (22/04/04)

Nothing to report.

DOY 2004.114 (23/04/04)

Nothing to report.

8.3.4 JEM-X Operations

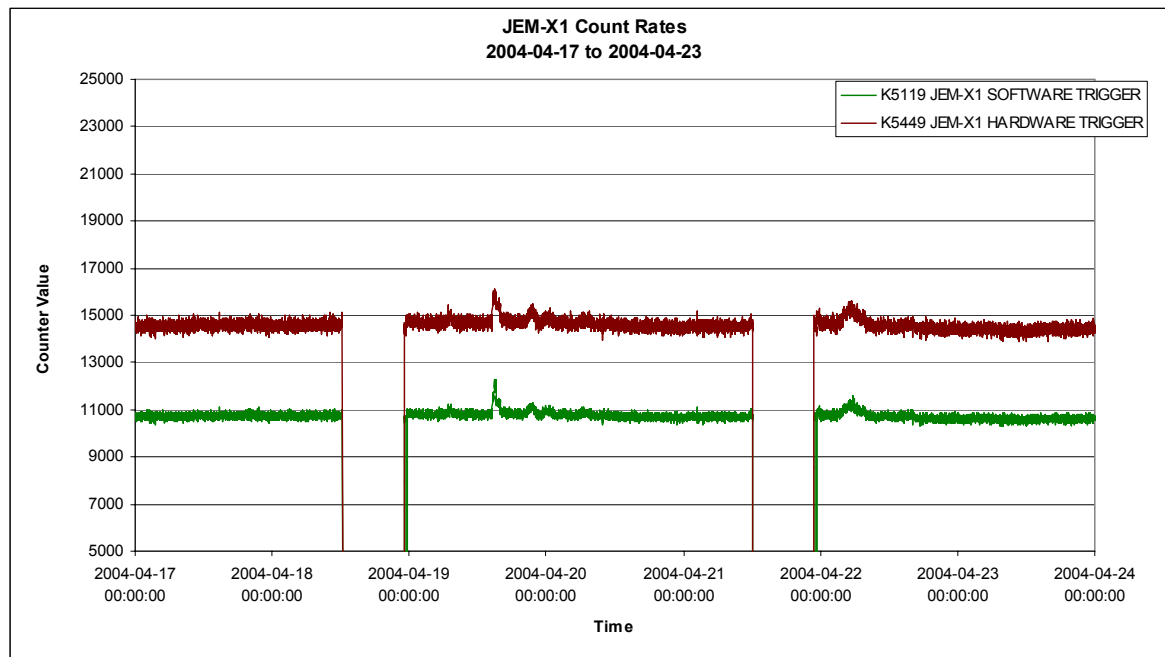
2004-04-17 (DOY 108, Rev 184) to 2004-04-23 (DOY 114, Rev 186)

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 103, at 12:02, a TM drop prevented the uplink of an AOCS command, stopping the slew to pointing 01820059. The manoeuvre and OMC commands were conducted manually, the impact was 14 minute delay in the start of the pointing.

On DoY 111, at 00:54:57, while executing pointing 01850043, the following exception OEMs were raised:

```
2004.111.00.54.57.448 2004.111.00.54.49.220 1792 Real Time Anomaly 5 OMC
CSSW INT ER
FIX6=0 M9079=2 M9080=5 M9074=4 M9067=5531
2004.111.00.54.57.400 2004.111.00.54.49.220 1792 Real Time Exception 7 OMC
CONSTRAINT D
M9073=4, IASW TASK 4 M9079=1 M9080=7 M9076=33 M9067=20216
```

This is a known problem triggered when the unit is observing a crowded region of the sky. The attitude at this time was: R.A.: 18:14:06.99 (hh:mm:ss), dec: -32:29:55.8 (dd:mm:ss), which is very close to the same point in the sky that caused the same effect noticed last week.

At 19:20, due to an AOCS commanding problem slews 01850076 and 01850077 were missed, it was at this time that the following pairs of commands were rejected:

```
2004.111.19.24.01.055 2004.111.19.23.49.387 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=630
2004.111.19.23.53.059 2004.111.19.23.42.887 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=629
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 01850076.

On DoY 109 at 13:41:12 and DoY 112 at 13:28:37, OMC was switched by the Timeline to SAFE mode, at the nominal times.

8.3.6 IREM Operations

IREM daily report

DOY 2004.109 (18/04/04)

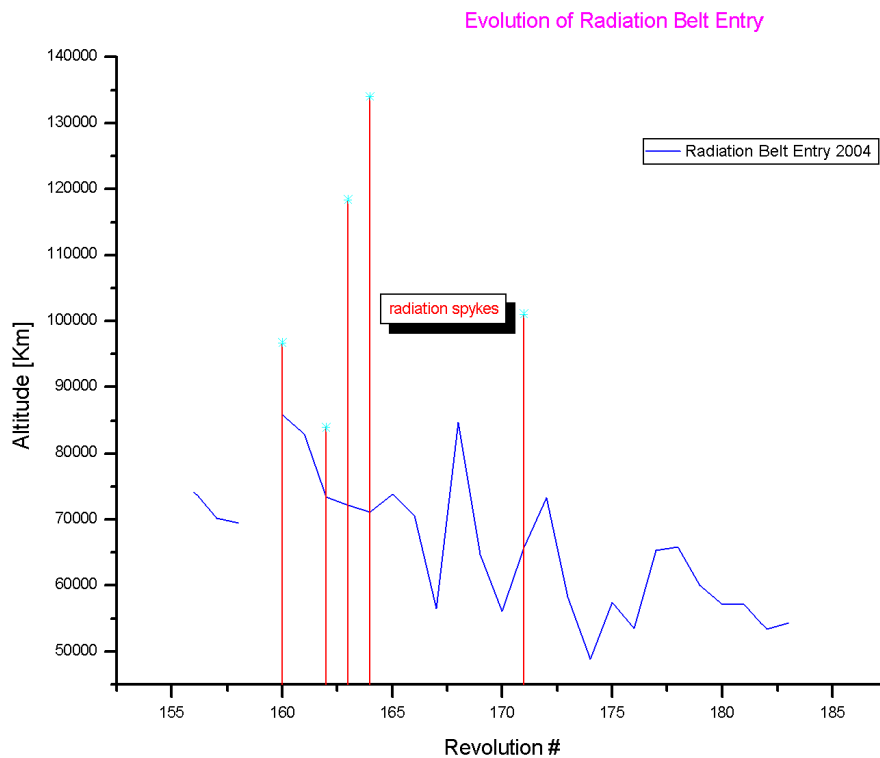
At 15:19Z the CEV (Command Execution Verification) failure for the TC U4921 (INT GND LINK OFF) was reported, due to a late TM verification in the Command Verifier Task. The operator verified the successful execution of the TC against the TM parameter U9903 (in TM Monitoring Task) and no further action was taken.

Solar Activity

The observation period was characterized by low solar activity.

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 184-->185, 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-OFF Observed Entry/Exit	Electron CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
184	RAD_ENTR R 2004-04-18T13:40Z	18/04/2004 14:02	18-Apr-2004 14:27	54832
184	RAD_EXIT R 2004-04-18T22:41Z	18/04/2004 21:04	18-Apr-2004 21:27	26280
185	RAD_ENTR R 2004-04-21T13:28Z	21/04/2004 14:53	21-Apr-2004 14:15	54663
185	RAD_EXIT R 2004-04-21T22:30Z	21/04/2004 21:04	21-Apr-2004 21:15	26379

Reference

Small error vs reference

Large error vs reference

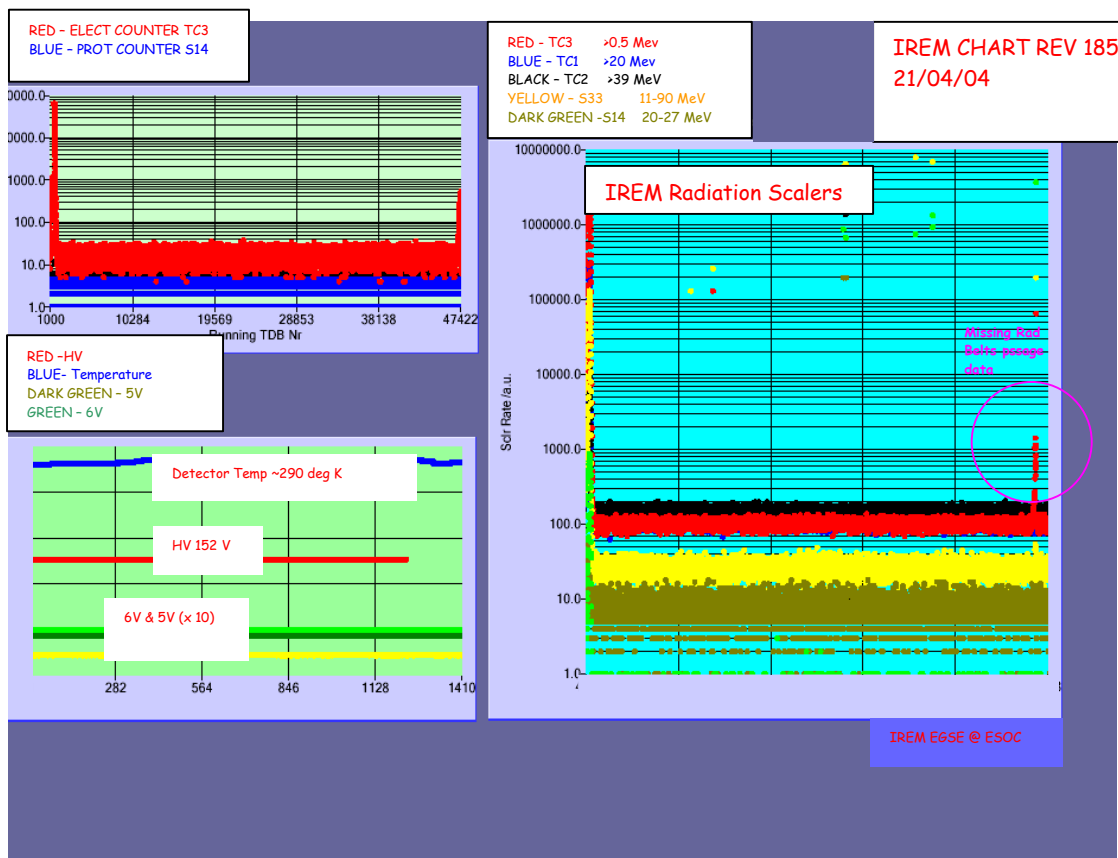
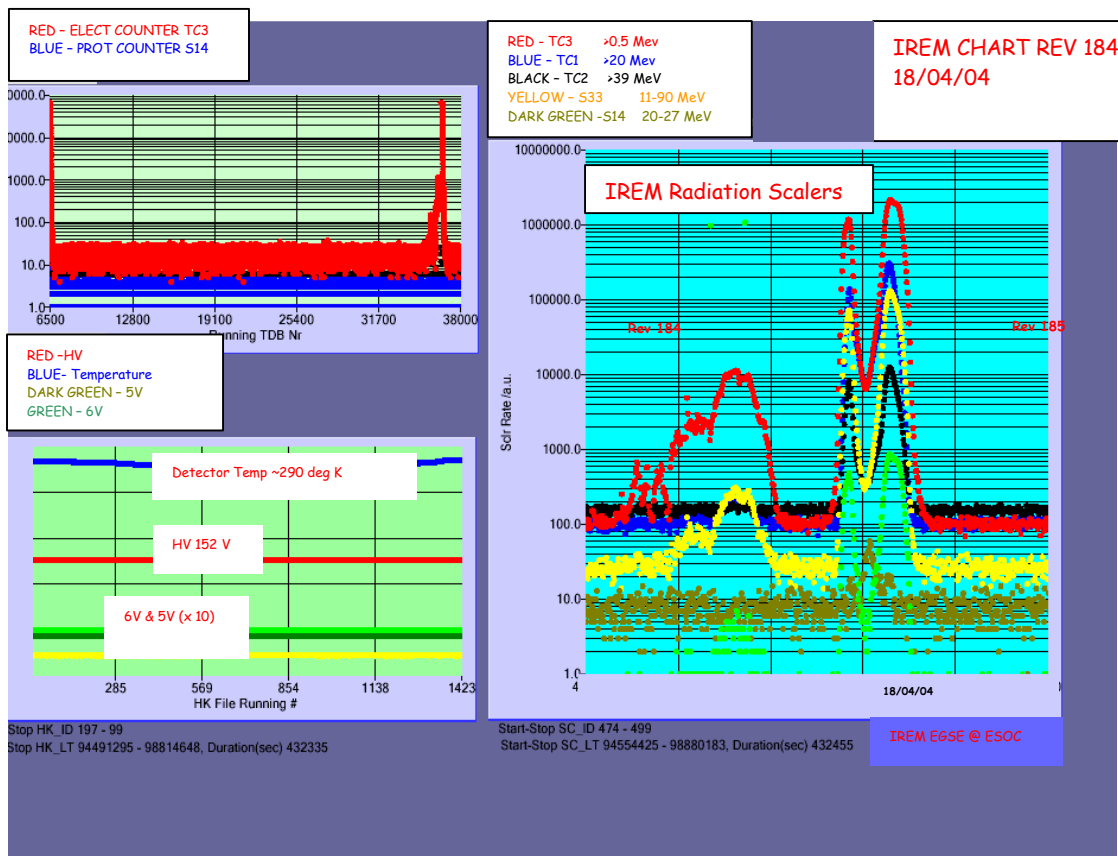
Radiation Spike

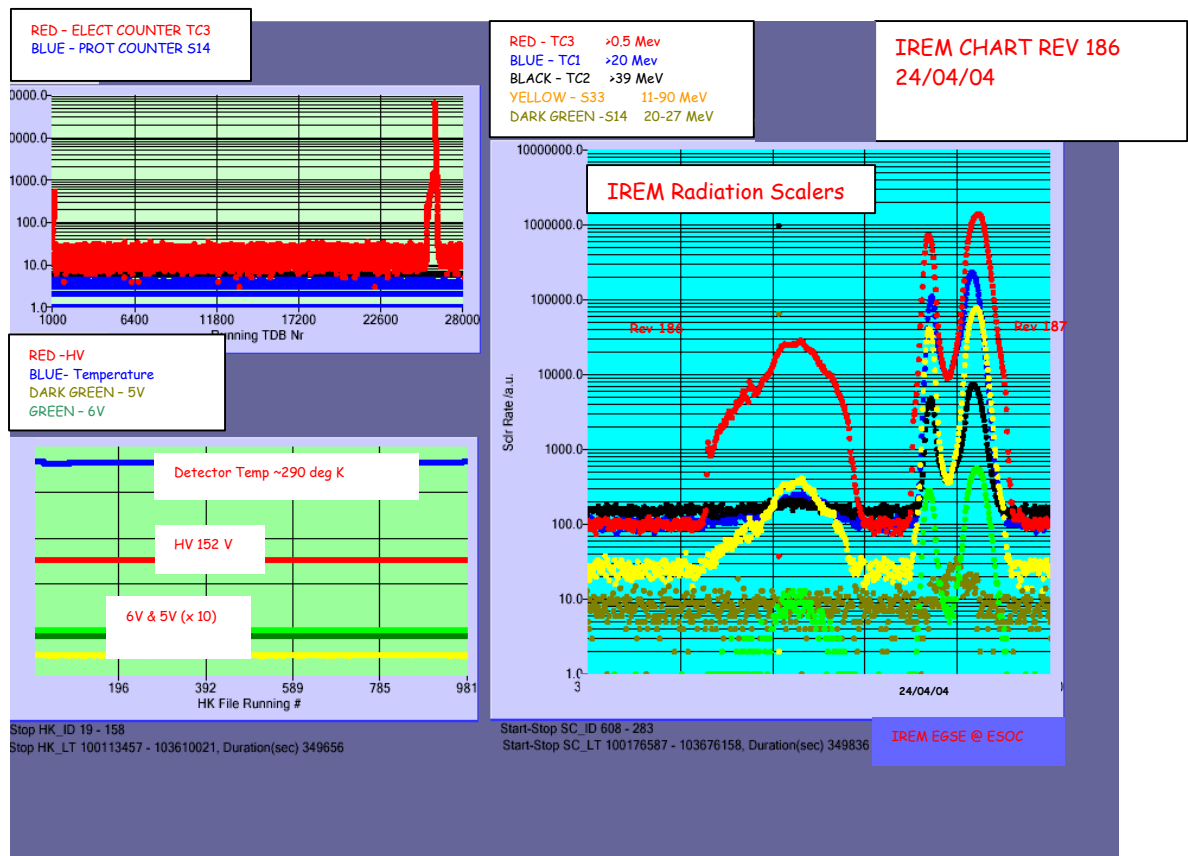
Proton Belts

REV	S/C BCPKT (proton)	Proton CUT-OFF Predicted Entry/Exit	ALT[Km] predicted
184	PROTON_RAD_ENTR	18-Apr-2004 19:47	11384
184	PROTON_RAD_EXIT	18-Apr-2004 20:17	14669
185	PROTON_RAD_ENTR	21-Apr-2004 19:35	11552
185	PROTON_RAD_EXIT	21-Apr-2004 20:05	14832

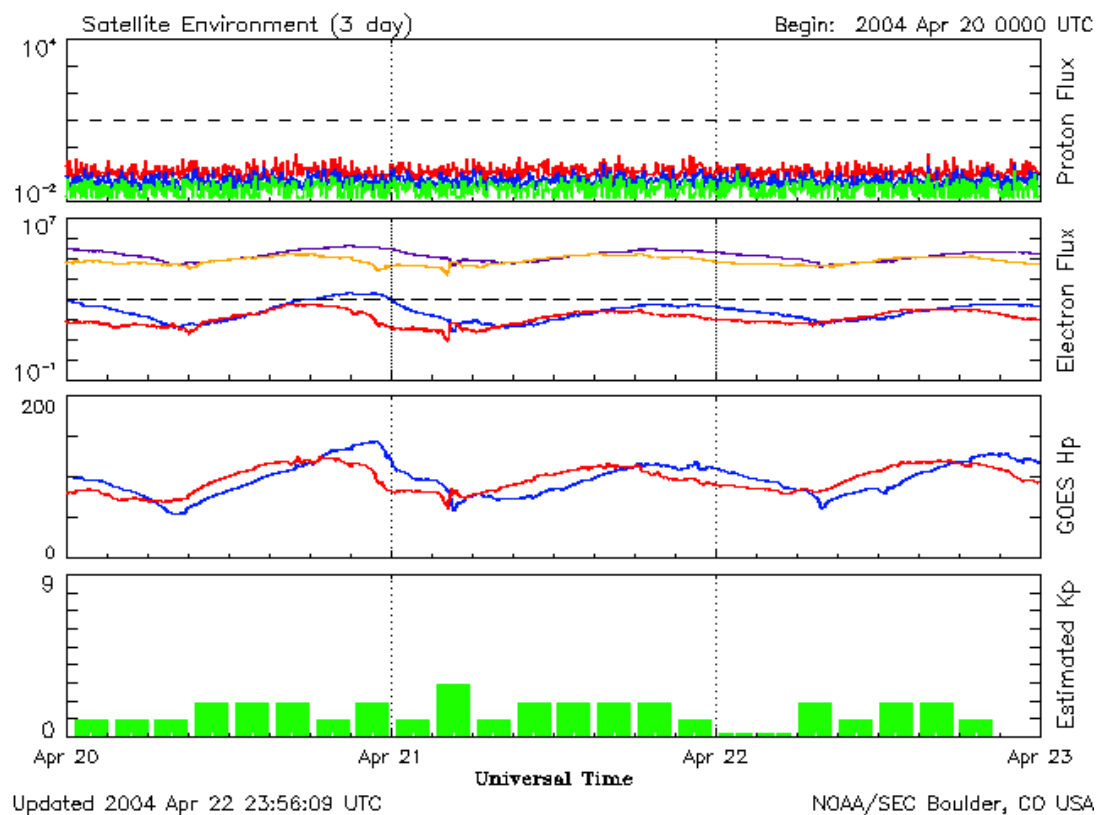
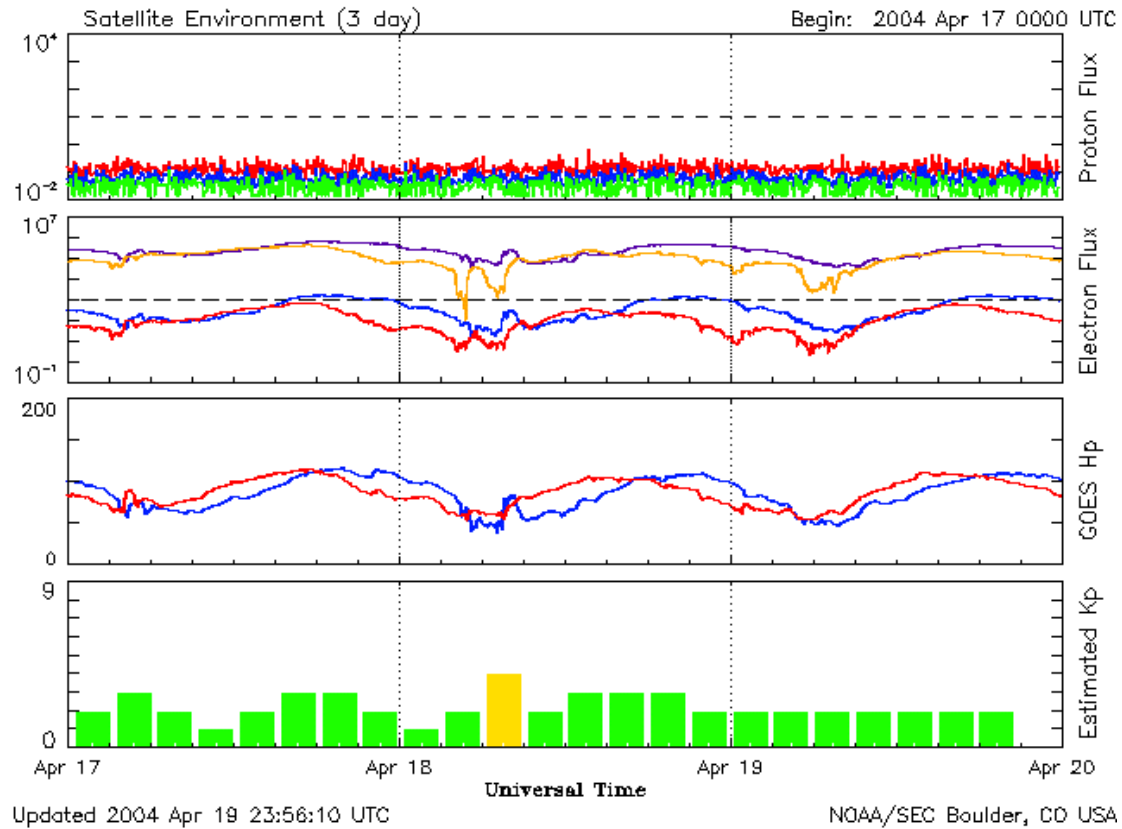
IREM radiation counters plot

Plots of the evolution of the IREM counters from revs 184, 185 & 186 are shown below:





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



The corresponding predictions for the Belts passages (as calculated with AP8Max and AE8Max models by using the RADMON tool) are:

