

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-TOS-OF
No. 079
Week 13
29.03.04
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 20.03.04 until 26.03.04 (both dates inclusive) and covers the revolutions 175, 176 & 177.

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 was the Galactic Centre. The activities consisted of 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.

There was a loss of Guide Star near the apogee of revolution 175, caused by detected False Events on the Star Tracker.

During the reporting period, there were also two cases of flickering of the Pointing-Bit due to attitude errors. The first case was caused by a Roll error after a corrective Open Loop Slew, which was introduced by a mapping during which the SSL was enabled. The second case was caused by a dim neighbor of the ACC picked Guide Star, which caused jumps in the position of the CCD image of the Guide Star. None of the two instances were seen at BCP level.

A few slews were missed because of problems at the ground stations and also due to a delay in release of Telecommands, introduced by the NCTRS.

The fuel consumption over the period between 19/03/2004 and 26/03/2004 was 0.145 kg. The remaining propellant is in the order of 171.620 Kg on the 26th of March.

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**.

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 and an assigned TM bandwidth in the science windows of 98 pkts/cycle.

The cryocooler is working well, keeping the Ge detector cold plate 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.

No occurrence of anomalous OEM generation (ID 183-184-179-180, Class 2) reported.

Since DoY 2004.64 the unit is working with the updated PICsIT binning table (HEPI table).

The low limits for the count-rate of the calibration Unit #1 was adjusted to cope with the natural decaying of the on-board radioactive (0.4 mCi of Na²², half life=2.58 years) source.

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.

During the reporting period JEM-X1 was active with 8 TM packets/cycle and JEM-X2 was dormant with only 1 TM 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 225 OMC pointings executed nominally, 1 partially and 6 totally lost.

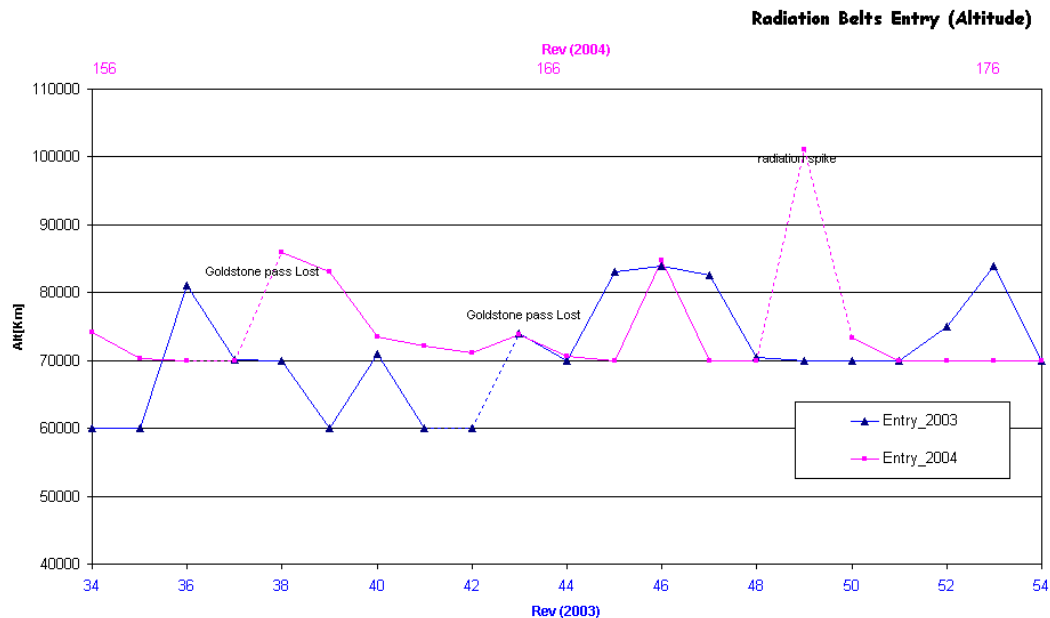
Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is Nominal.

The observation period was characterised by low solar activity and no isolated radiation spikes were reported.

A comparison between the Radiation Belt Entries in 2003 and 2004, along the same observation period winter->spring is shown below:



The Radiation Belts 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 175-->176, as defined by a cut-off flux of 3.76×10^2 e/cm²/sec ($E > 0.5$ MeV) and the predicted Proton Belts Entry/Exit, as defined by a cut-off flux of 1.25×10^3 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
175	RAD_EXIT R 2004-03-20T00:51	19/03/2004 23:	19-Mar-2004 23:31	26802
175	RAD_ENTR R 2004-03-22T15:40	22/03/2004	22-Mar-2004 16:23	54348
176	RAD_EXIT R 2004-03-23T00:40	22/03/2004	22-Mar-2004 23:13	25314
176	RAD_ENTR R 2004-03-25T15:29	25/03/2004	25-Mar-2004 16:07	55038
177	RAD_EXIT R 2004-03-26T00:29	25/03/2004	25-Mar-2004 23:07	26095

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
175	PROTON_RAD_ENTR	22-Mar-2004 21:43	11551
175	PROTON_RAD_EXIT	22-Mar-2004 22:13	15201
176	PROTON_RAD_ENTR	25-Mar-2004 21:27	11239
176	PROTON_RAD_EXIT	25-Mar-2004 21:57	14464

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 in general good this week well fulfilling the system requirements. There were occasional problems distributing the data. This concerned the links from / to the stations and to the ISDC. In addition there were a few problems with the station handovers to Goldstone.

4.1 Mission Operations Centre

The performance of the MOC was good in the reporting period. There was no malfunction that impacted the execution of the Timeline.

4.2 Ground Stations & Network

The performance of the ground stations and Network was in general good this week, but there were still problems with links to the ground stations and station handovers

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

PSF's: Received up to rev. 186

POS and POD generated: up to rev 186

TSF's: Received up to rev 179

No replanning performed. No ToO alerts received. Long term plan is stable.

2. Observation status

ECS up to revolution 163 received except rev. 151. Corresponding OCS's sent to ISDC.

3. ISOC science archive

A tape with observation group data from ISDC is announced. The use of FTP to obtain data products faster is waiting for implementation on ISDC side.

4. ISOC system

The ISOC system version 10.3 introduced last week has been used without problems this week.

5. Problems

The effects of the problem reported a couple of weeks ago related to selection of OMC mode has been further investigated. The wrong use of FAST mode is much less frequent than firstly thought. Wrong mode has been used in less than 30 % of all pointings.

4.3.2 ISDC

On 29/03/2004, the status of ISDC observation processing is:

- Latest Standard Analysis completed: observation 01100090006 (Vela region, Revolutions 137-141) on 15/03/2004
- Latest products archived: observation 01200230006 (3C 273, Revolution 148-149) on 12/03/2004
- Latest observation products sent to the observer: observation 01200230006 (3C 273, Revolution 148-149) on 17/03/2004

5 Special Events

Nothing to report

6 Anomalies

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

- On DoY 081, at 14:33, 4 bad frames were received from DSS-16, there was no impact.
- On DoY 082, at 00:08, there were occasional errors sending data to the ISDS.
- Later, at 10:49, there were problems during the handover from Redu to DSS24. Slew 01750105 and the sequence DEBPG200 were lost, however, the attitude was safe for the perigee pass. The corresponding DR# is G104211. At 11:11, VC0 & VC7 TM were being processed after a receiver swap, and at 11:50 a manual manoeuvre was performed. The Timeline was rejoined at 12:00. The impact was slews 01750105, 01750106 & 01750107 were lost.
- At 14:00, there was a brief drop in TM from DSS24; no impact.
- At 14:25, there was a 4 minute period when idda indicated 'red', without apparent impact.
- On DoY 083, at 05:38, inctrb indicated yellow, with disk usage at 99%.
- Later, at 08:15, after it was noticed that comparison of the wheel speeds with the expected profile was erratic, a new profile was loaded in the FD system, and all was well.
- On DoY 084 at 03:04, a sun steering law command failed due to a late CEV. The impact was pointing 01760051 was lost, pointing 01760052 was recovered manually.
- On DoY 084, at 06:00, the idda was in a yellow state with disk space at 5GB.

- Later, between 06:43 and 06:49, there were errors sending data to the isds. Checks within the MOC showed no problems, no further action was taken when the messages stopped after about 6 minutes. ISDC informed at 08:25.
- On DoY 084, at 13:20, DSS16 was unable to supply the command link, rebooting the TCP1 failed to cure the fault. The link was recovered at 13:49 by switching to TCP2. The impact was that pointing 01760069 was missed.
- On DoY 085, at 11:50 idda went yellow with 3.5 GB of free disk space.
- Later, at 23:21, the FD server failed to determine the attitude for slew 01770001. It was later established that the TLM processing for FD service had stopped at 17:12.
- On DoY 086, at 05:28, both the TM & TC links with Redu dropped. The TM was restored at 05:30, and after a full re-cycle of the TC chain the up-link was restored at 05:41. The impact was the loss of pointings 01770009 and 01770010.
- At 06:28, the TC-link was disconnected due to "processing ranging data". The link was restored at 06:34, the impact was AEINT_00 (RMV calibration) had to be manually sent.
- At 15:10, there was a brief interruption in the links when the NCTRS was swapped from A to B, as NCTRS-B showed yellow due to low swap space, the reverse switch was performed at 15:20, NCTRS-B was rebooted, and at 15:51 switched online again.

There were no new anomalies entered into the Anomaly Reporting and Tracking System this week.

7 Future Milestones

The modification of the SPI TM packet distribution will be tested on 31 March.

JEM-X 2 will be activated on 02 April for a check of the performance.

The battery reconditioning will start mid April.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 175

The observations in revolution 175 consisted of a GCDE* (grid 1) performed for ~19 hours, interspersed by a raster dithering observation of the source IGR J1618-4848** (RA 16:31:48; DEC -48:49:00) for ~15 hours and by a hexagon dithering of the PSR B1259-63*** (RA 13:02:47; DEC -63:50:08) ~6 hours.

* The Galactic Centre Deep Exposure consists of deep exposures of the central Galactic radian (+/- 30 deg in longitude, +/- 20 deg in latitude, centered on (l, b) = (0, 0). Individual pointings (30 min exposure each) on a regular pointing grid with 2.4 and 1.2 deg spacing, respectively.

** The IGR J1618-4848 is a high-mass X-ray binary and is the first newly discovered source by Integral.

*** The PSR B1259-63 is a TOO outside the TAC.

Revolution 176

The observations in revolution 176 consisted of raster dithering observations of the region Sagittarius Arm Tangent** (RA 19:00:01; DEC +06:55:17) for ~21 hours and by an hexagon dithering of the PSR B1259-63*** (RA 13:02:47; DEC -63:50:08) ~34 hours.

** The Sgr Arm Tangent is a region of enhanced X-ray source density.

*** The PSR B1259-63 is a binary system composed by a radio millisecond pulsar orbiting a Be star in a very eccentric orbit. The observation is a ToO.

Revolution 177

The observations in revolution 177 consisted of raster dithering observation of the region Sagittarius Arm Tangent** (RA 19:00:01; DEC +06:55:17) for ~36 hours and by GPS*** for ~20 hours.

** The Sgr Arm Tangent is a region of enhanced X-ray source density.

*** The Galactic Plane Scan survey is made out of 1 scan per 12 days or 4 revolutions ("slew, stop, stare") along a saw-tooth path (inclined at 21 deg wrt gal equator). Each scan consists of a series of individual exposures (2200 sec each) separated by 6.0 deg along the scan path. Individual scans are shifted by 27.5 deg in galactic longitude

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

2004-03-04T16:46:15.000Z	171.9986	F	Automatic TM processing.
2004-03-05T00:30:47.000Z	171.9782	F	Automatic TM processing.
2004-03-06T10:44:27.000Z	171.9542	F	Automatic TM processing.
2004-03-08T00:20:39.000Z	171.9219	F	Automatic TM processing.
2004-03-10T13:19:18.000Z	171.9008	F	Automatic TM processing.
2004-03-11T00:13:11.000Z	171.8557	F	Automatic TM processing.
2004-03-13T17:26:54.000Z	171.8492	F	Automatic TM processing.
2004-03-13T23:48:23.000Z	171.8481	F	Automatic TM processing.
2004-03-15T09:38:34.000Z	171.8288	F	Automatic TM processing.
2004-03-16T16:00:37.000Z	171.8088	F	Automatic TM processing.
2004-03-16T23:38:46.000Z	171.7653	F	Automatic TM processing.
2004-03-19T23:27:25.000Z	171.7437	F	Automatic TM processing.
2004-03-22T23:17:17.000Z	171.7353	F	Automatic TM processing.
2004-03-25T15:12:52.000Z	171.6783	F	Automatic TM processing.
2004-03-26T07:37:33.000Z	171.6502	F	Automatic TM processing.

This report was generated Fri Mar 26 08:00:14 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, 90 Open Loop Slews, 149 Closed Loop Slews and 5 Momentum Bias were executed. 9 slews were missed or executed manually. This is equivalent to a 3.8%.

20/03/04 (Day of Year 080, Revolution 175)

Nothing to report.

21/03/04 (Day of Year 081, Revolution 175)

Guide Star released due to detected False Events on the STR: The STR SEU Filter of the ACC released the Guide Star at 15:38:53 when the number of detected False Events on the STR exceeded the threshold of the filter. The 6.55 Mi Guide Star was

picked by the ACC after Open Loop Slew 01750069 and was located at CCD location [1409, 12805]. This caused the OTF to drop low. However, it was not during a science observation. An automatic mapping was commanded and a new Guide Star was found: [2783, -8755], 8.4 Mi. The altitude was about 148500 km.

22/03/04 (Day of Year 082, Revolution 175-176)

Slews lost due to ground station problem (Goldstone, DSS-24): After station handover from Redu to Goldstone, the JPL Data Control could not process the VCO telemetry (DR# G104211) and the links could not be established. The problem was not fixed until 11:11 and slew 01750105 was missed from the Timeline. To rejoin the Timeline, a manual Open Loop slew was performed to the attitude of PID 01760107, which was reached at 11:55:57. PIDs 01760105 to, and including, 01760107 were affected.

23/03/04 (Day of Year 083, Revolution 176)

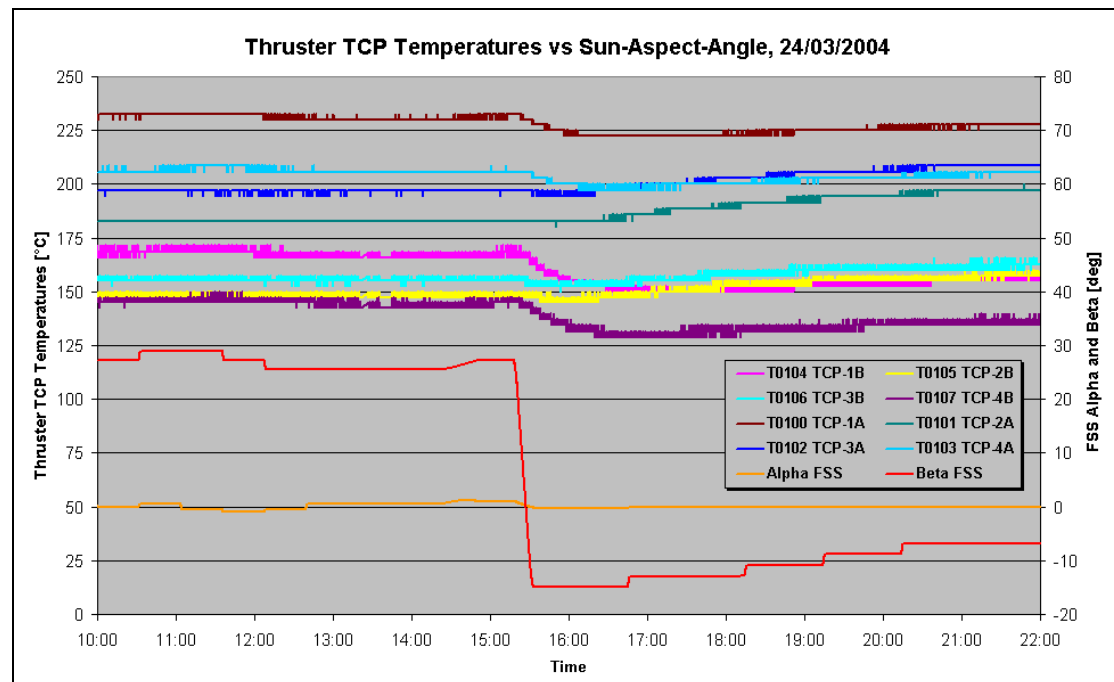
Nothing to report.

24/03/04 (Day of Year 084, Revolution 176)

Slew missed due to delay in the release of Telecommand: At 03:04, an AOCS command to load the SSL parameters failed uplink because the verification of the previous interlocked command was still pending. The reason is believed to be delay in the release of commands, introduced by the NCTRS (refer to the related section of this report for further details about this problem). Slew 01760051 was missed. To rejoin the timeline, a manual Open Loop Slew was performed to the attitude of PID 01760052, which was reached at 03:30:46. This was before the planned time in the Timeline.

Slew missed due to problem at the ground station (Goldstone, DSS-16): After station handover from Redu To Goldstone, DSS-16, the TC link could not be established due to a problem at the station. At 13:20 the Timeline was stopped and slew 01760069 was missed. After establishment of the TC link at 13:49, a manual Open Loop Slew was performed to the attitude of PID 01760070. This attitude was reached at 14:53:16. The next slew was executed from the Timeline.

Temporary drop of the TCP-4B temperature below the OOL warning limit: With the start of slew 01760072 at 15:17:26 and change of the Beta angle from +27 degrees to -15 degrees, the temperatures of the thruster thermocouples on the -Z side (thrusters 1 and 4) started to decrease. Around 16:22 the temperature of TCP-4B, which is generally lower than the other Thruster TCP temperatures, reached the lower warning limit of 130 °C and OOL warnings were generated on its temperature. The lowest temperature reading of TCP-4B was 128.6 °C. The temperatures slowly increased through the following pointings as the Beta angle gradually increased. The thermal behavior of all thruster TCPs during this period can be seen in the following plot:



25/03/04 (Day of Year 085, Revolution 176-177)

Flickering of the Pointing-Bit at the end of Open Loop Slew, because of Roll Error: At the end of the corrective Open loop Slew 01760096, the error in roll angle with respect to the SSL assumed value was -204 arc-seconds. This roll error caused the flickering of the Pointing-Bit, but was not seen at the BCP level. The error was already there at the start of the slew and was originally introduced by the attitude determination after Open Loop slew 01760095. This attitude determination was based on a STR mapping during which the SSL was enabled. The actual error in roll, WRT the SSL assumed roll angle, after slew 01760095 was $+178$ arc-seconds and the roll error reported by the attitude determination process (0176_0096.attd_log) after this slew was $+202.6$ arc-seconds.

26/03/04 (Day of Year 086, Revolution 177)

Slew missed due to loss of all links from the ground station (Redu): At 05:28 all the links from the ground station were lost and could not be fully restored until 05:41. Slew 01770009 was missed. A manual Open Loop Slew was performed to the attitude of PID 01770010. PIDs 01770009 and 01770010 were affected.

Flickering of the Pointing Bit due to Yaw Errors: At the end of Open Loop slew 01770025, the ACC-picked Guide Star was located at CCD location [11203, 4343], with a magnitude of 7.95 Mi. The catalogue number of this star is 3708-0056. Starting at 17:34:25 and until the end of the pointing, the guide star position made jumps of about $+40$ arc-seconds on the STR Z axis. The Yaw threshold was exceeded five times with a period of about 2 minutes. Looking into the star catalogue, there is a close-by star with a magnitude of 9.2 located at a distance of about $+75$ arc-seconds in Z from the Guide Star. The catalogue number of this star is 3708-0753. Apparently, the effect of this dim star has caused the jumps in the CCD image of the Guide Star and has therefore caused the Yaw errors.

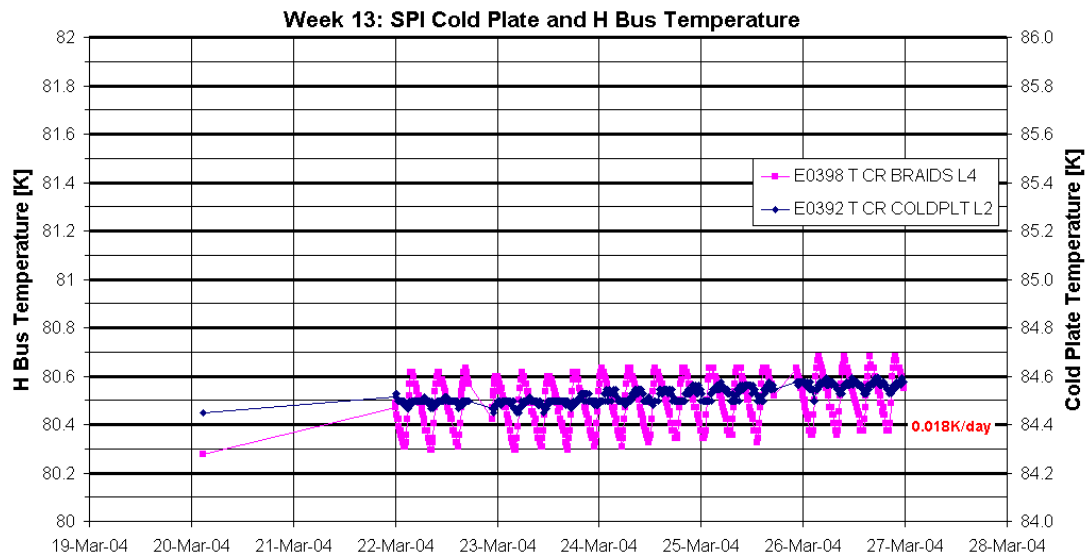
8.3.2 SPI Operations

Cryo-cooler / Detector Cold-Plate:

The performance of the cryo-cooler is nominal.

The cold plate temperature is leveled off at around 80.5K with a small positive drift of 0.018K/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.

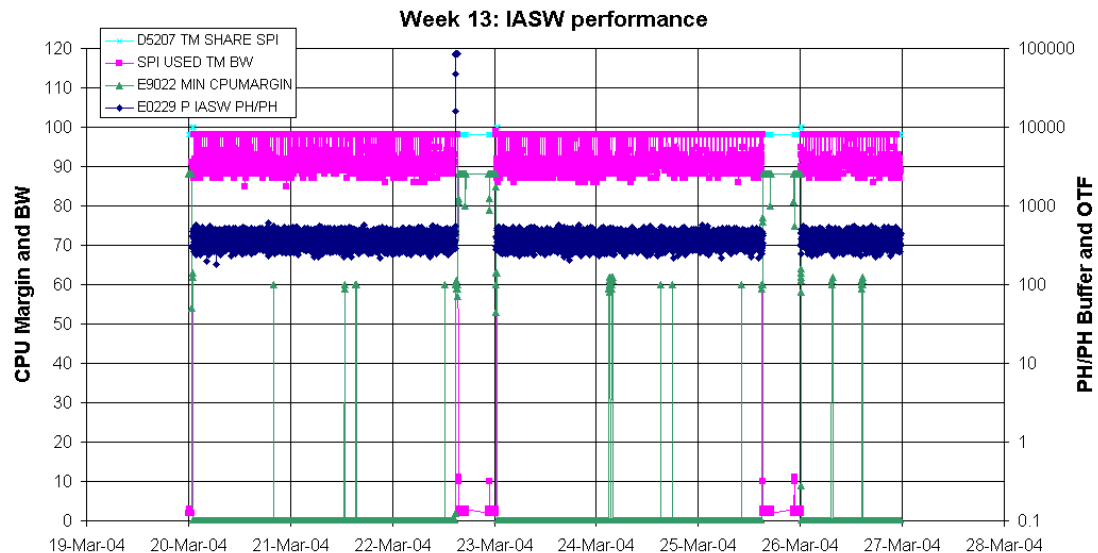
The Change Request to re-route the 5 science housekeeping packets from VC7 to VC0 has been processed, importing the database packet definitions into the IMCS database and the new commands and sequences to deal with the change. The simulator has been upgraded to generate the new packets and some system tests have been conducted to validate on-ground the change.

The in-flight test is scheduled on 31st March at 15:03z, at critical altitude entry (<60000km). The test will consist of:

- 1- Critical altitude entry: automatic transition to conf/protégé and switch off of ACS hv power supplies.
- 2- Execution of FCP_SPI1_0300 to inhibit reactions to belts times and automatic reconfiguration. The instrument mode will change from conf/protégé to conf/commanded.
- 3- Execution of FCP_SPI1_0332 to load the new APID table for sci hk packets.
- 4- Execution of FCP_SPI1_0130 to enter photon mode and check that the sci hk packets are actually routed through VC0 and that the IMCS is correctly processing them.
- 5- Execution of FCP_SPI1_0160 to go back in conf.
- 6- Execution of FCP_SPI1_0332 to re-load the old APID table for sci hk packets.
- 7- Execution of FCP_SPI1_0130 to enter photon mode and check that the sci hk packets are actually routed again through VC7.
- 8- Execution of FCP_SPI1_0160 to go back in conf.

- 9- Uplink of TPF ES1700_IASW-PAR_fmconfig.vvvv.TPF: The instrument mode will change from conf/commanded to conf/protégé.
- 10- Critical altitude exit: Monitor the correct mode transition to photon/commanded and automatic reconfiguration

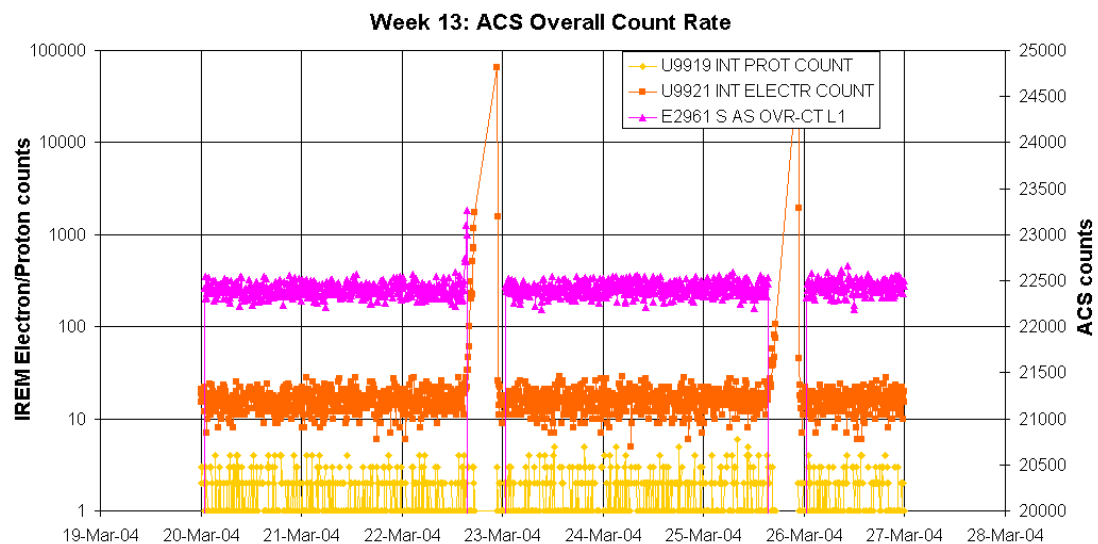
The following plot shows the IASW performance in terms of TM bandwidth and event buffer occupation during the reporting period:



ACS:

The performance of the ACS is nominal.

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

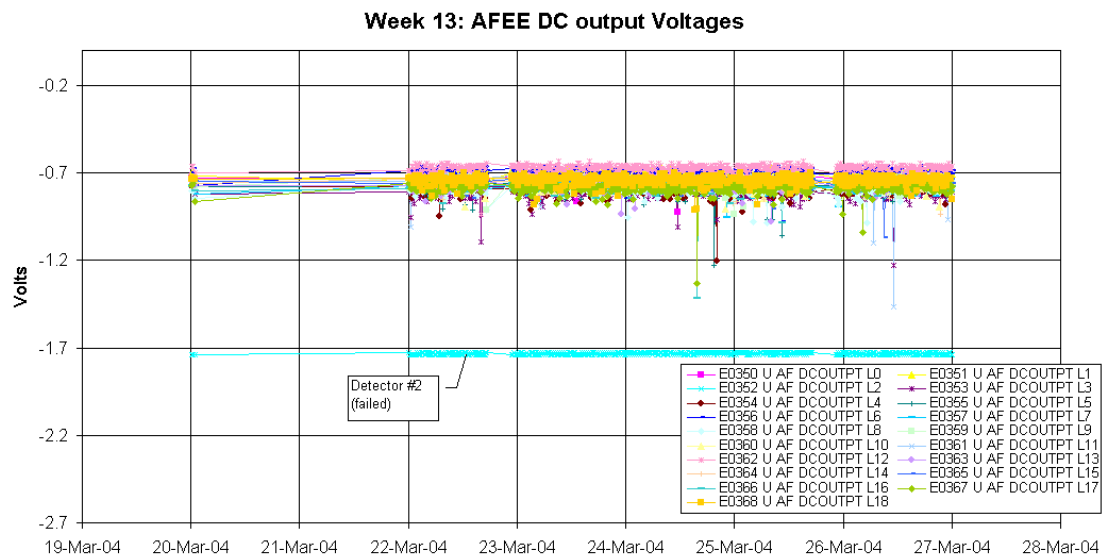


AFEE:

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.

These signals represent the DC component of the current flowing through the Ge detector crystals polarised at 4kV; they provide a measure of the health status of both the detectors and the HV section.

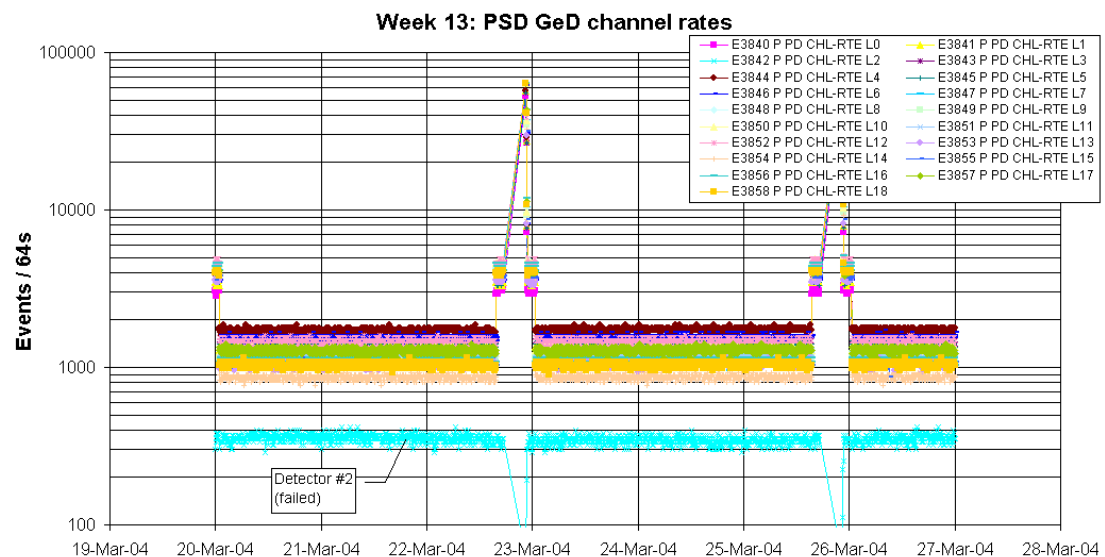


DFEE:

Nothing to report.

PSD:

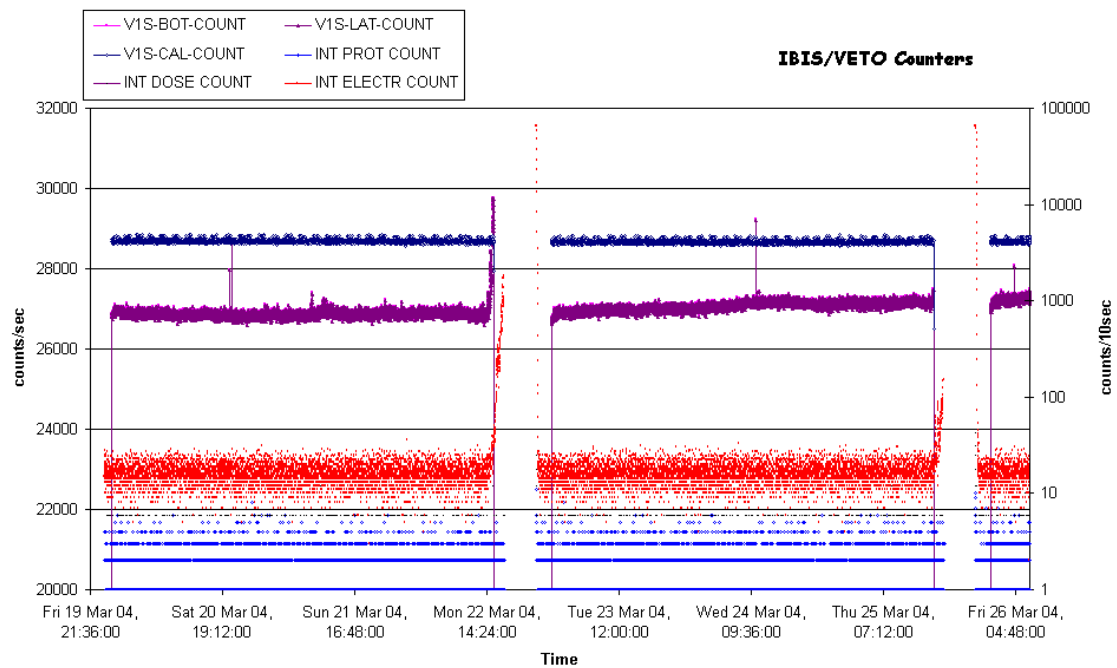
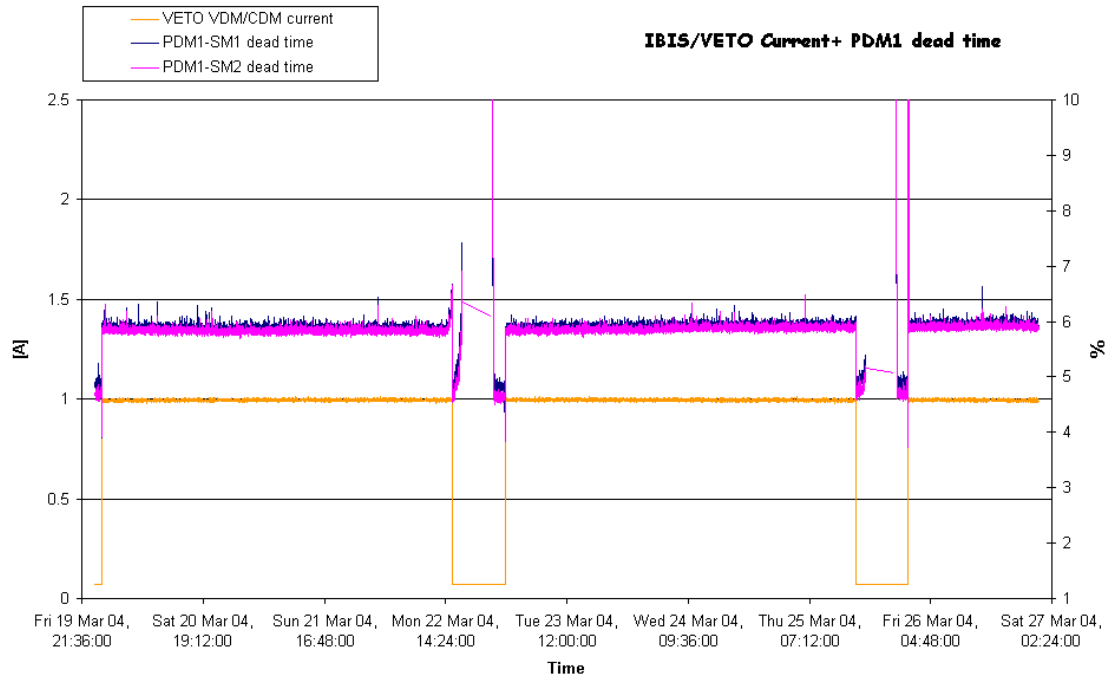
The following plot shows the GeD channel rates detected by the PSD during the reporting period. The count rate of each detector is within the expected range, except for the failed detector #2, whose residual counts are triggered by noise.



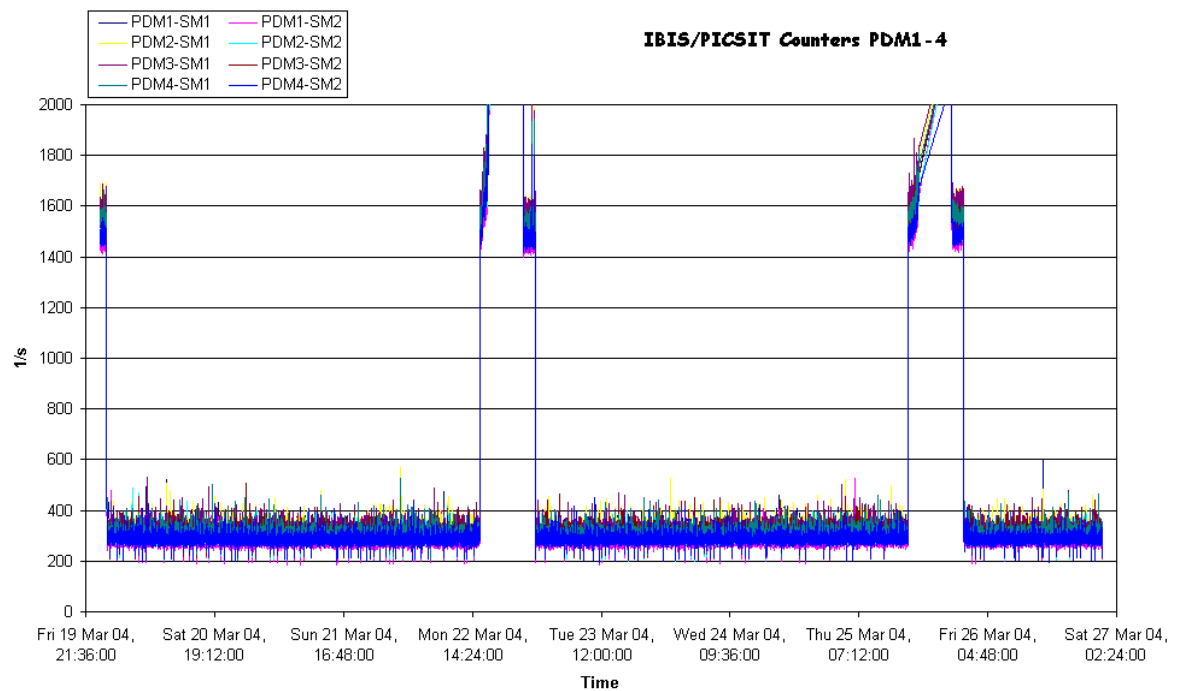
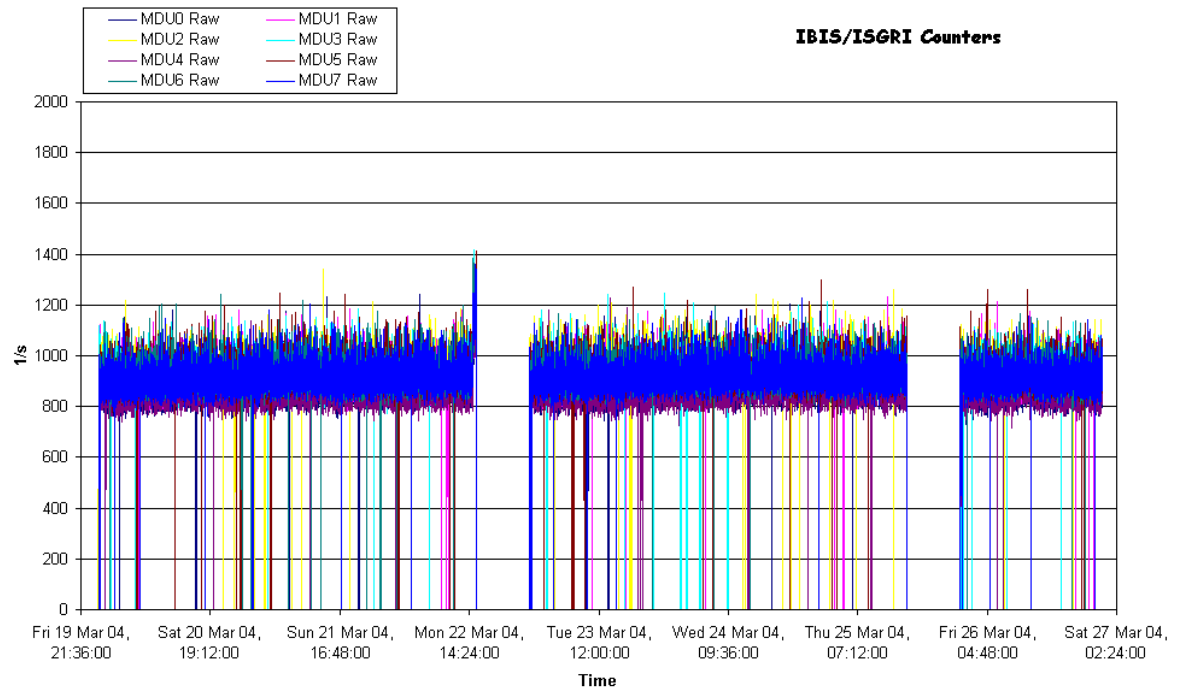
8.3.3 IBIS Operations

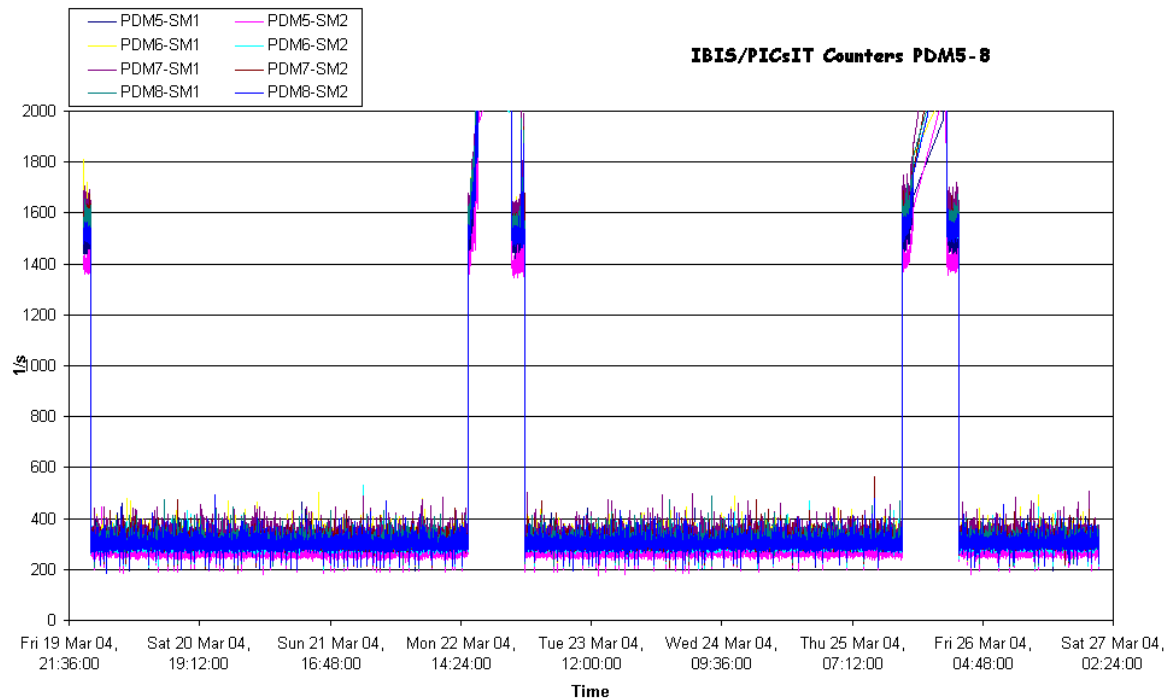
IBIS event counters plot

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:



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





IBIS daily report

DOY 2004.080 (20/03/04)

At 00:48Z the parameter G2014 (ISGRI overflow pixel address) went in and out of limit SCC failure. The reason was the incoming Radiation Belt Entry (00:51Z). No further action was taken as at the Belt Entry (3 minutes later) the ISGRI Modules autonomously switched to Stand-By with Biases OFF.

An occurrence of the parameter G6061(VIS-CAL-COUNT) in Hard low limit (went in/out limit for few TM cycles). This parameter is reporting the count-rate of the calibration Unit #1 and this low limit is due to the decaying of the on-board radioactive the source (0.4 mCi of Na²²).

DOY 2004.081 (21/03/04)

Nothing to report.

DOY 2004.082 (22/03/04)

Nothing to report.

DOY 2004.083 (23/03/04)

During the day, several occurrences of the parameter G6061(VIS-CAL-COUNT) in Hard low limit (went in and out of limits for a few TM cycles).

DOY 2004.084 (24/03/04)

Nothing to report.

DOY 2004.085 (25/03/04)

Nothing to report.

DOY 2004.086 (26/03/04)

Updated the low limit for the parameter G6061 (VETO Calibration Unit #1): the current reference value is 3500 counts/sec, in agreement with the input of the IBIS PIs and the Exponential Decay calculated since the switch ON of the calibration unit.

8.3.4 JEM-X Operations

Nothing to report.

8.3.5 OMC Operations

No commands were rejected this week.

On DoY 082, at 10:49, handover problems caused the loss of pointings 01750105, 01750106 and half of 01750107

On DoY 084 at 03:04, AOCS problems caused the loss of pointing 01760051.

On DoY 084, at 13:20, due to TC problems, pointing 01760069 was missed.

On DoY 086, at 05:28, due to problems with the links to Redu, pointings 01770009 and 01770010 were lost.

On DoY 082 at 15:41:06 and DoY 085 at 15:29:38, OMC was switched by the Timeline to SAFE mode, at the nominal times.

8.3.6 IREM Operations

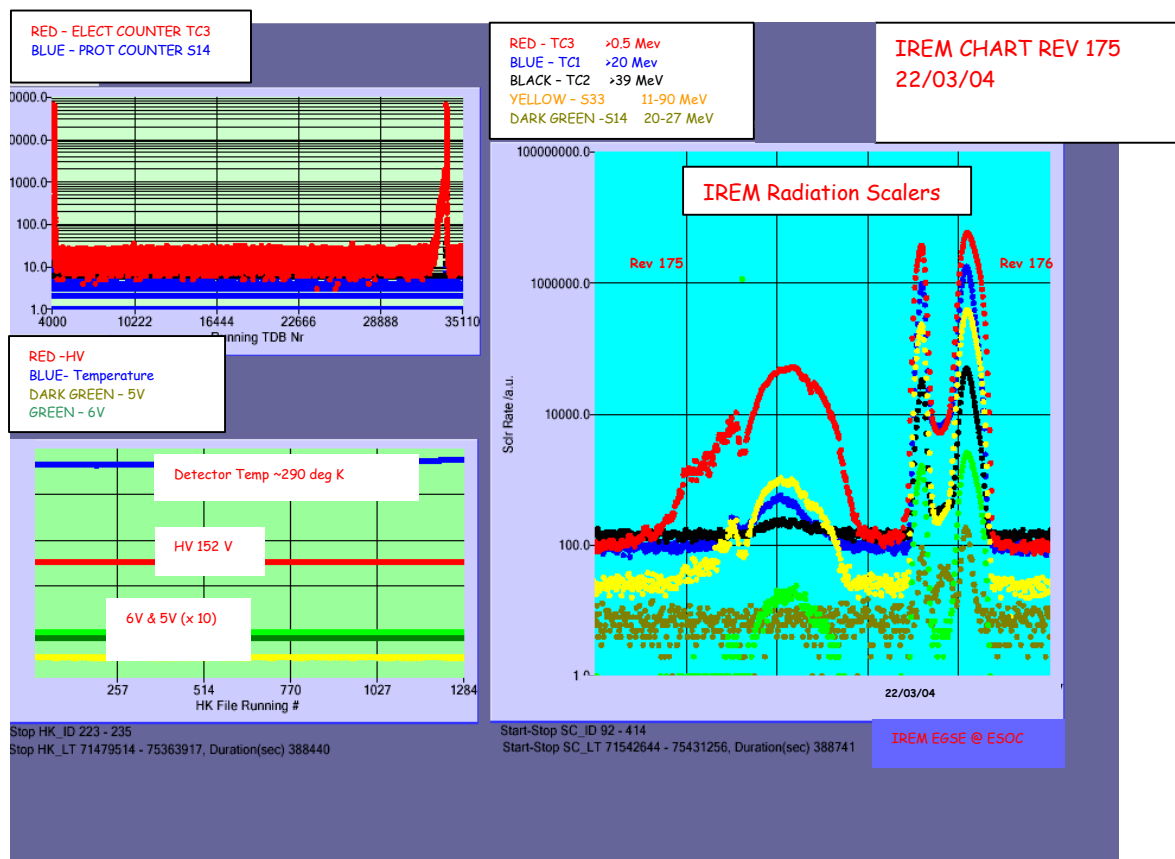
IREM daily report

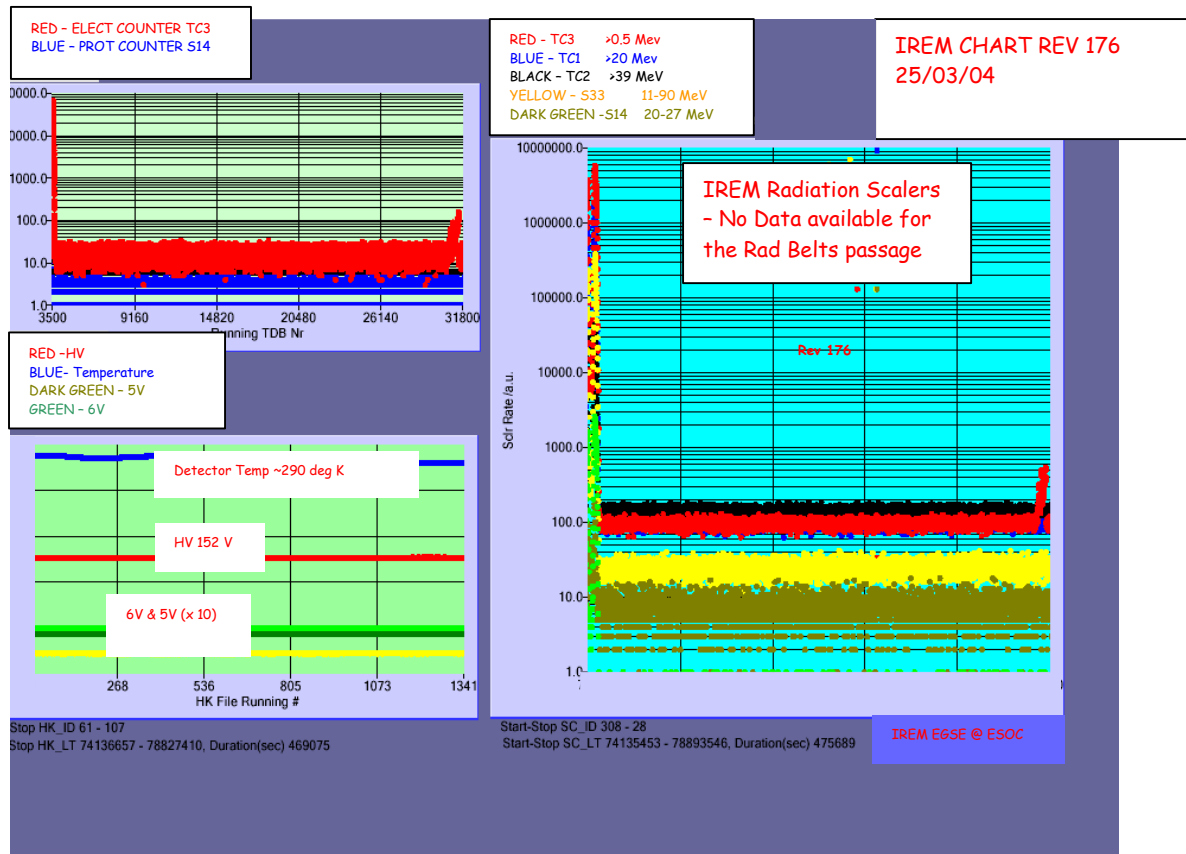
DOY 2004.085 (25/03/04)

At 17:01Z the failure of the Command Execution Verification for the TC U4921 (INT GND LINK OFF) due to late TM verification was reported. The correct TM status was verified, no further action was taken.

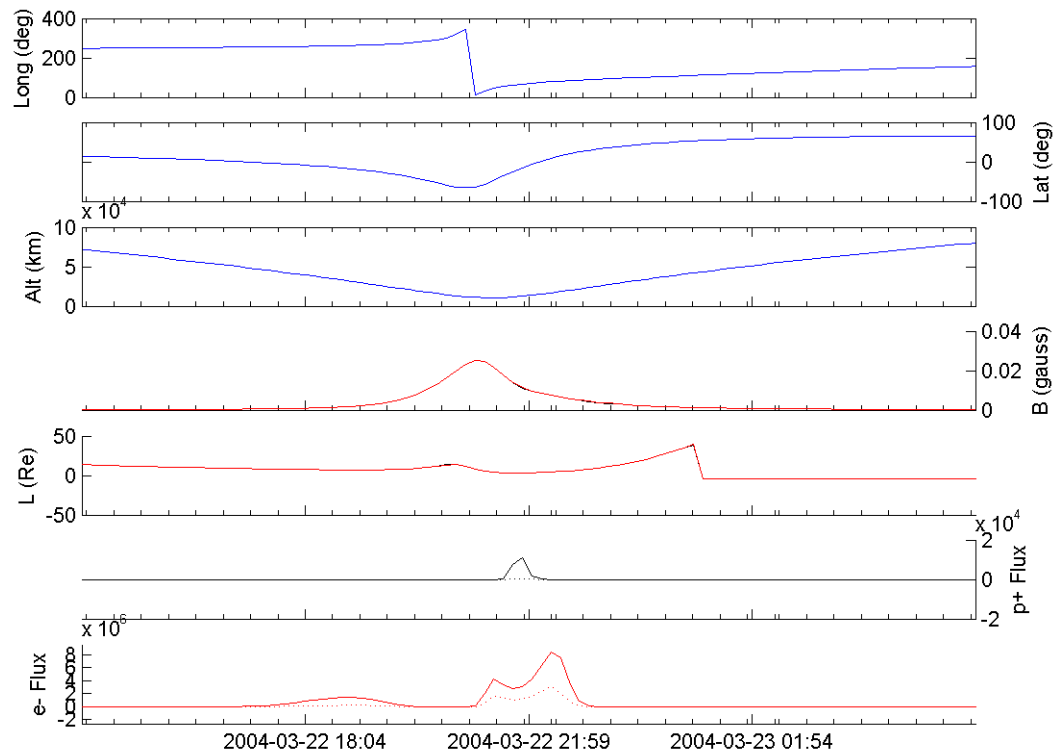
IREM radiation counters plot

Plots of the evolution of the IREM counters from rev 175-176 are shown below:

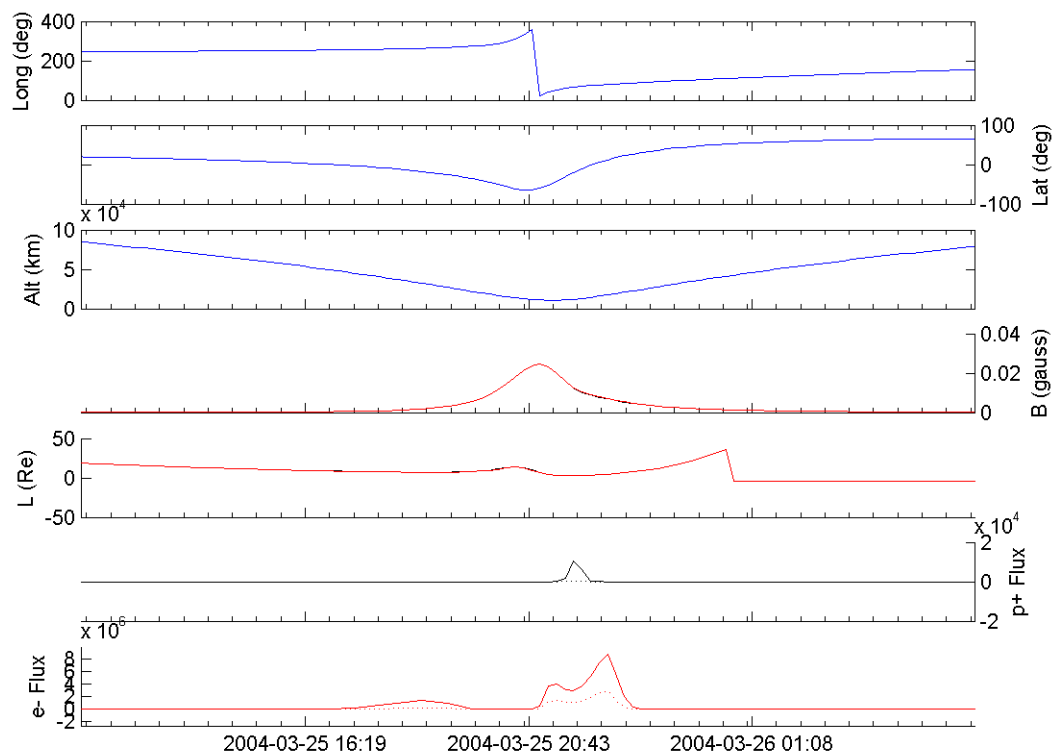




The corresponding predictions for the Belts passages (as calculated with AP8Max and AE8Max models by using the RADMON tool) are:



X: 0 Y: 0 [get Data](#) [Zoom](#) [Print...](#)



X: 0 Y: 0 [get Data](#) [Zoom](#) [Print...](#)