

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-OPS-OF
No. 185
Week 14
10.04.06
Routine Phase

Prepared by: M. Walker (OPS-OFO)

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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 01.04.06 until 07.04.06 (both dates inclusive) and covers the revolutions 424 and 425.

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 hexagonal and raster dithers of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0) and the Galactic Centre (RA 17:45:40.00; DEC -29:00:28.0) respectively.

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

3 Satellite Status

3.1 Platform

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

3.1.1 AOCS

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

No slews were lost during the observation period.

The fuel consumption over the period between 28/03/2006 and 06/04/2006 was 0.1485 kg. The remaining propellant is in the order of 155.2995 Kg.

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.

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

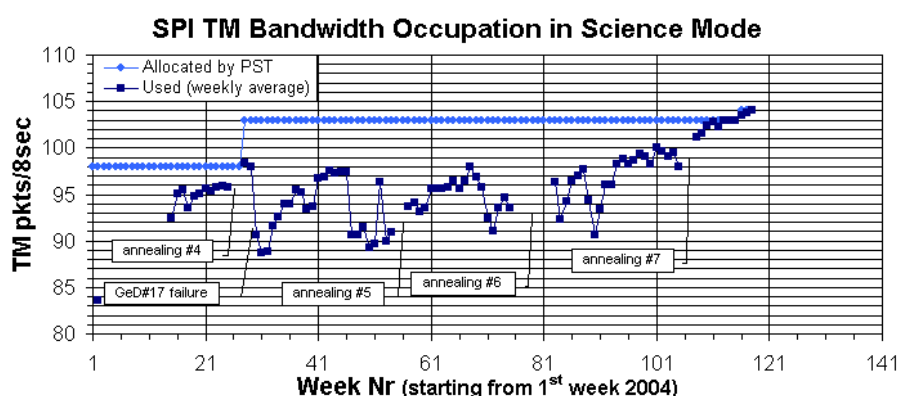
Following the 7th annealing, ended on 24th January, the overall status of the gamma-ray spectrometer is nominal, except for the Ge detector #15, which has been showing a slightly degraded energy resolution since 09.02.2006. Detector #2 is failed since 06.12.2003, detector #17 since 17.07.2004.

During science operations, the instrument was kept in photon-by-photon mode, with spectra TM enabled, the assigned TM bandwidth in the science observation windows of 104 pkts/cycle and the average telemetry occupation was 104 pkts/cycle.

The telemetry downlink of SPI has therefore reached the saturation.

The Stirling compressors work nominally, maintaining the Germanium detectors at 85K +/-1K.

The following plot shows the assigned and the average occupation of the SPI TM bandwidth.



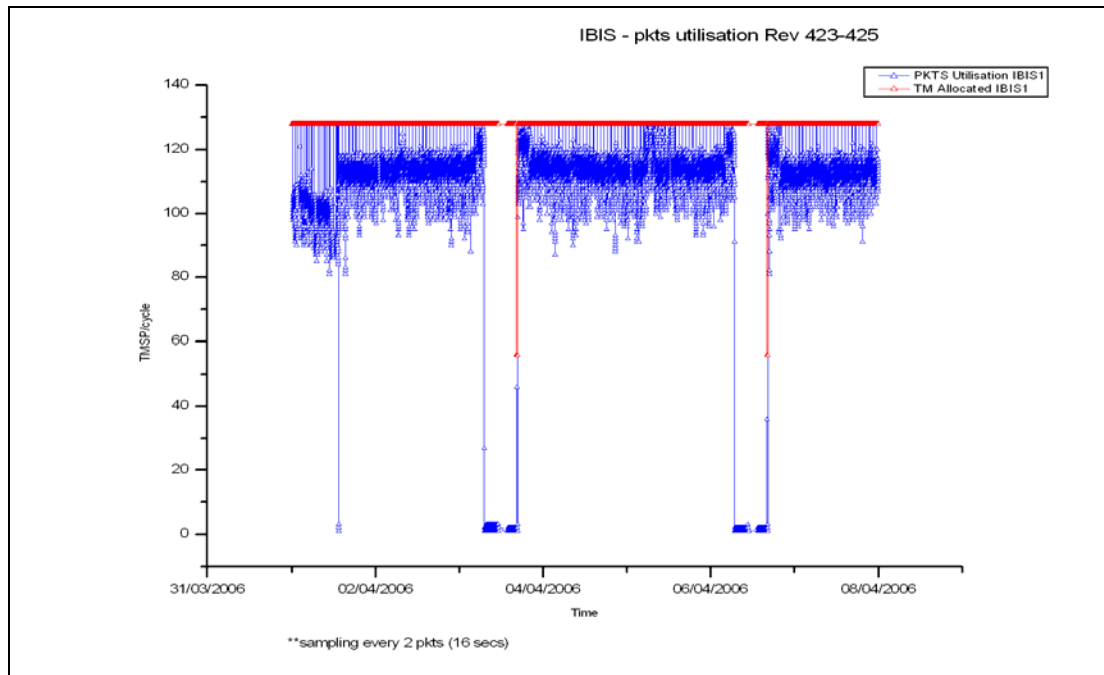
Note: Some more information concerning the SPI operations is provided in the Appendix.

3.2.2 IBIS

The Overall status of the unit is nominal.

During the reporting period, the PST allocation to IBIS was 128 TMPS/cycle. The IBIS mean bandwidth utilisation during the observation period was 113.25 TMPS/cycle, down 4.08 on last week.

A plot of the IBIS TM utilisation during the observation period is shown below:



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

3.2.3 JEM-X

The status of both JEM-X units is nominal.

JEM-X operations were performed by the automatic Timeline.

JEM-X1 was operated in Data Taking mode with a TM allocation of 8 packets/cycle during science observations and JEM-X2 was dormant (DFEE OFF) 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.

OMC operations were performed by the automatic Timeline. OMC was operated in Science Normal mode during science observations, with a TM allocation of 5 packets/cycle, except during Revolution 422, when it was set to 4 packets/cycle.

During this reporting period, all of the 156 planned science pointings for OMC were executed nominally.

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

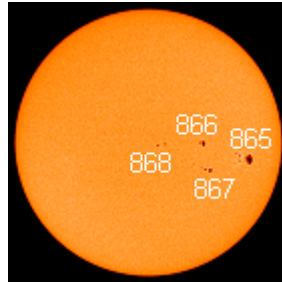
3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity

The observation period was characterised low to moderate solar activity.

Sunspot 865 that appeared on 28/03/2006 was posing threat of solar flares during the whole observation period. On 06/04/2006 (cf. picture) it emitted two M1-class solar flares, but no radiation were reported on INTEGRAL. This sunspot started decaying on 07/04/2006.



Reference: www.spaceweather.com

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

4 Ground Facilities

The Operational ground facilities performance was very good this week. There were several minor problems with ground station and ISDC links, but these had no impact. The overall performance was well over the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was excellent this week. There were only minor problems reported, which had no impact. The overall performance was well over the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week. There were several instances of bad frames and TM drops, plus a couple of problems sending data to the ISDC, but these had no impact on the mission. The overall performance though was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

1. Mission planning

New PSF's for revolution 430 to 434 have been received. Planning for up to revolution 423 have been performed and files sent to MOC and ISDC. No ToO request was received. Revolution 430 was replanned once to correct an instrument parameter setting during the OMC flat field calibration due in this revolution. TSF for revolutions 428 and 429 were received.

2. Observation status

ECS for all revolutions up to 414, except 413 are now available. The corresponding OCS's have been sent to ISDC. No extra time is credited.

3. ISOC science data archive

A version 2.5.1 is ready for release next week. This version contains a tidying up of the handling of multiple versions of a data set. Due to reprocessing of the science data in ISDC more disk space will be required very soon in ISDA. Action is initiated. The next major release (version 2.6) is now planned for during the summer.

4. ISOC system

The ISOC system version 12.3 has been used. A patch was introduced to resolve a minor problem. The new helpdesk system was introduced operationally this week. It has considerably reduced the SPAM mail. The new system will also allow the community to enter helpdesk requests via the web.

5. AO 4

Proposals continue to appear in ISOC. Due to unavailability of the ACROBAT Distiller on LINUX in ESAC the procedure for producing the proposal data package for the TAC members has to be modified. Rework of these procedures is initiated.

6. Problems

The archive hardware problem is still remaining. Preparation for hardware replacement from another vendor is in progress.

4.3.2 ISDC

Status of ISDC observation processing on 10/04/2006:

- Latest Standard Analysis completed: observation 03200580001 (3C 279, Revolutions 397-399) on 07/04/2006
- Latest products archived: observation 03200560001 (Cas A /Tycho, Revolution 386) on 03/04/2006
- Latest observation products sent to the observer: observation 02297000019 (Cas A, Revolutions 352 & 384-385) on 13/02/2006

5 Special Events

6 Anomalies

There were no problems relating to the ground segment that impacted operations this week.

There were no new anomaly reports entered into the ARTS system this week:

7 Future Milestones

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 424

The observations in revolution 424 began with a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0), for ~3.5 hours. The rest of the orbit was devoted to a raster dither of the Galactic Centre (RA 17:45:40.00; DEC -29:00:28.0), which lasted ~55.1 hours.

Revolution 425

The observations in revolution 425 began with a hexagonal dither of the Galactic Bulge region (RA 17:45:36.00; DEC -28:56:00.0), for ~3.5 hours. The rest of the orbit was devoted to a raster dither of the Galactic Centre (RA 17:45:40.00; DEC -29:00:28.0), which lasted ~55.1 hours.

Throughout these observations all instruments were in their nominal science modes, except JEM-X2 for which the DFEE was off, and the TM allocation in this revolution is IBIS 128; SPI 104; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

2006-03-22T15:31:43.000Z	155.5826	F	Automatic TM processing.
2006-03-23T00:54:00.000Z	155.5260	F	Automatic TM processing.
2006-03-24T02:25:07.000Z	155.5090	F	Automatic TM processing.
2006-03-25T15:26:15.000Z	155.5030	F	Automatic TM processing.
2006-03-27T01:46:59.000Z	155.4851	F	Automatic TM processing.
2006-03-28T08:50:46.000Z	155.4740	F	Automatic TM processing.
2006-03-28T11:16:14.000Z	155.4620	F	Automatic TM processing.
2006-03-28T15:09:51.000Z	155.4480	F	Automatic TM processing.
2006-03-31T09:40:15.000Z	155.4272	F	Automatic TM processing.
2006-03-31T14:54:15.000Z	155.4069	F	Automatic TM processing.
2006-04-01T00:02:08.000Z	155.3696	F	Automatic TM processing.
2006-04-02T01:26:27.000Z	155.3487	F	Automatic TM processing.
2006-04-03T14:32:07.000Z	155.3347	F	Automatic TM processing.
2006-04-05T01:39:14.000Z	155.3135	F	Automatic TM processing.
2006-04-06T14:15:10.000Z	155.2995	F	Automatic TM processing.

This report was generated Fri Apr 7 08:00:34 GMT 2006

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, 01/04/2006 – 07/04/2006

AOCS operations were executed from the Automatic Timeline.

During this period, 94 Open Loop Slews, 70 Closed Loop Slews and 4 Momentum Bias were executed.

No slews were lost during the observation period.

Orbit Control

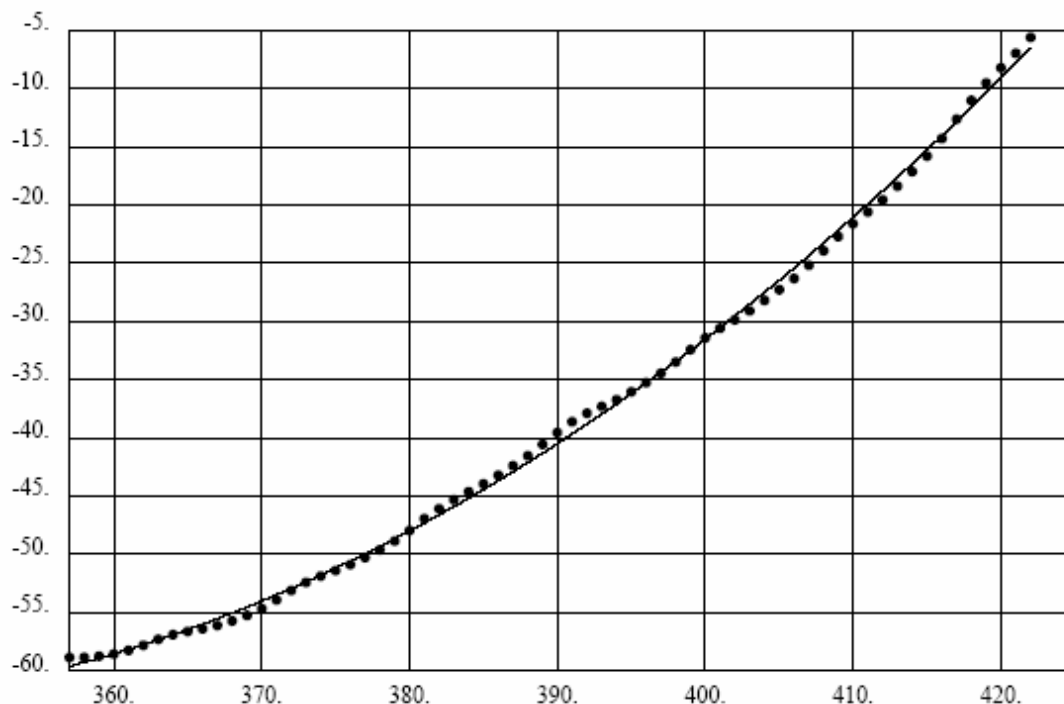
At present time the target is to reduce the eastward drift, by reversing the control and to increase the semi-major axis. From mid July onwards Redu should have coverage down to 40000 km altitude. The apogee longitude will be about 32 deg East.

The following table shows the shortening of the necessary Goldstone pass:

Orbit number	Apogee passage date	Time from LOS Redu to 40000 km altitude
362	2005/10/01	284 min
372	2005/10/31	268 min
382	2005/11/30	244 min
393	2006/01/02	213 min
402	2006/01/29	188 min
412	2006/02/28	159 min
422	2006/03/30	122 min

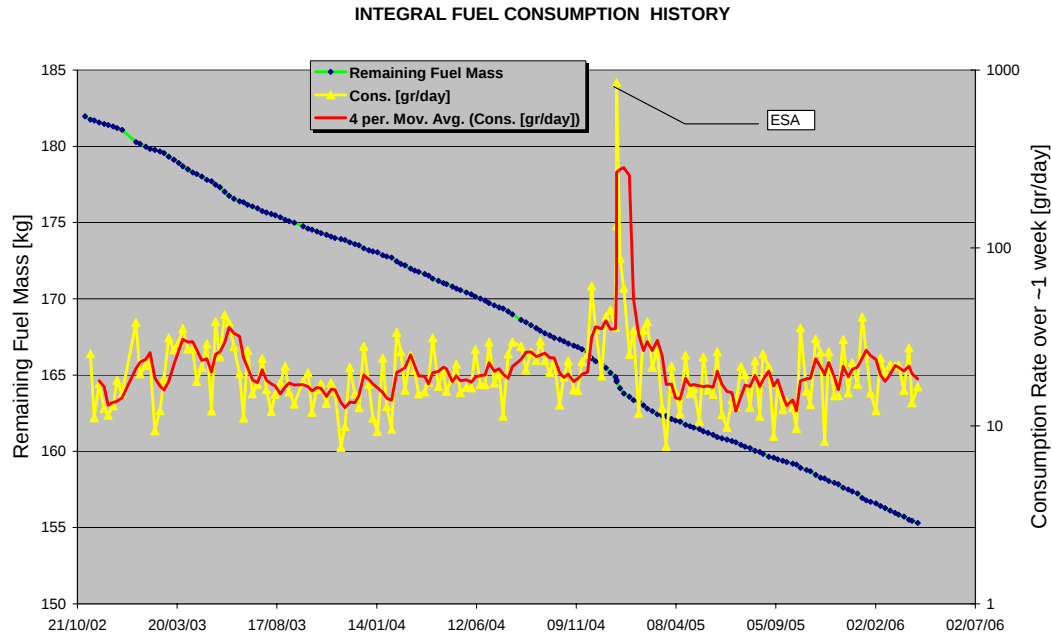
The attached plot shows the apogee longitude of Integral as a function of the orbit number. According to the linear least squares approximation with a parable the drift rate is 1.30 deg eastward shift per orbit at the end of the period.

APOGEE LONGITUDES OF INTEGRAL 16.9.2005 - 01.04.2006
 LEAST SQUARES APPROXIMATION WITH PARABLE

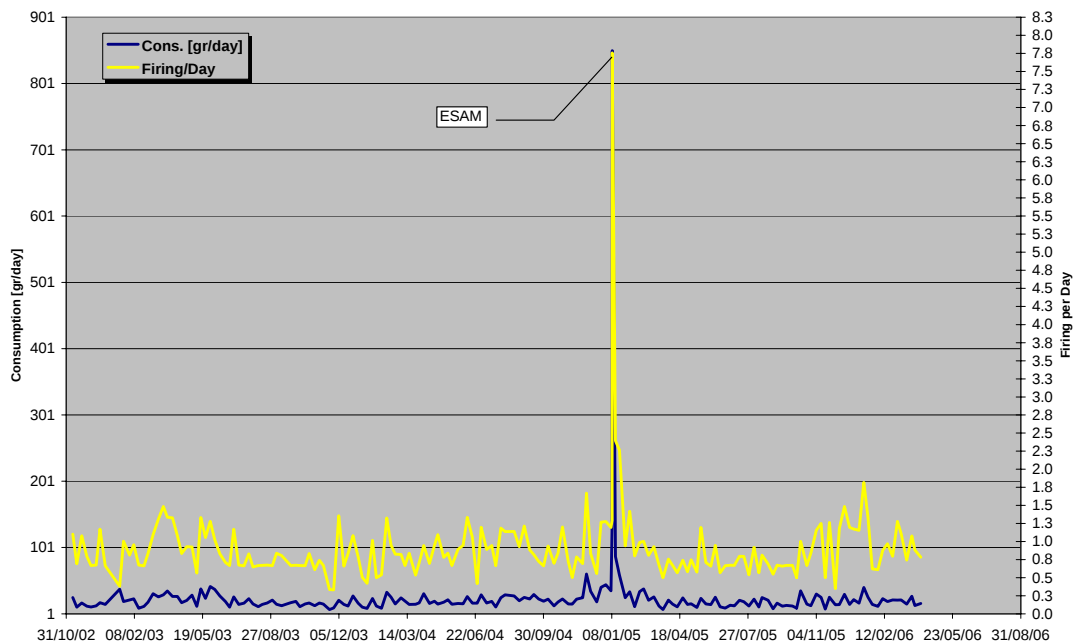


Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 06/04/2006 is reported in the plot below.

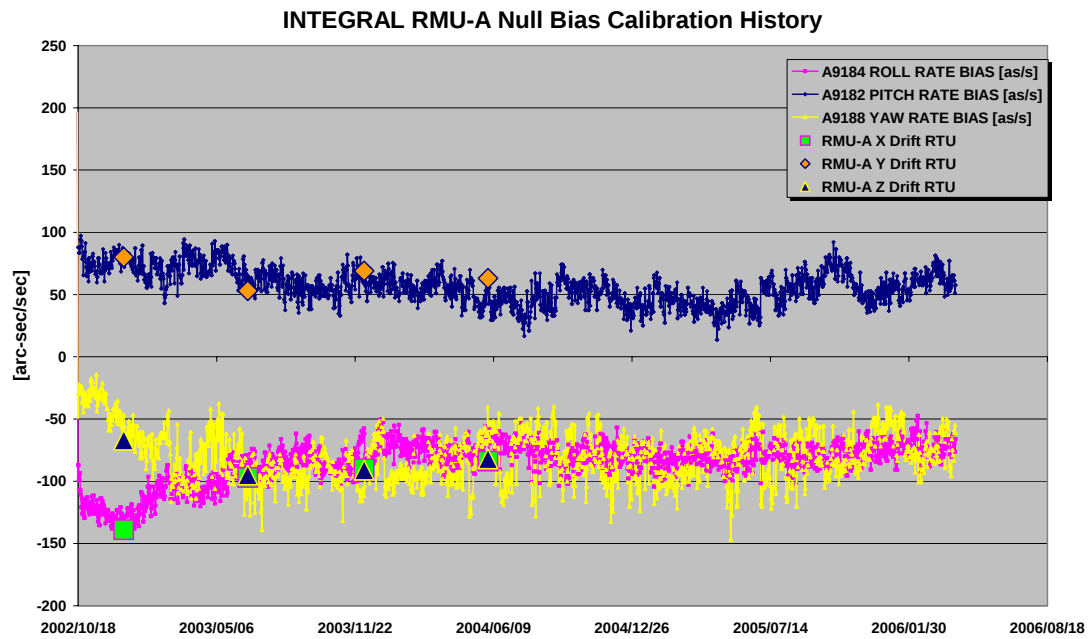


The firing\day over the period between 01/11/2002 and 06/04/2006 is reported in the plot below.

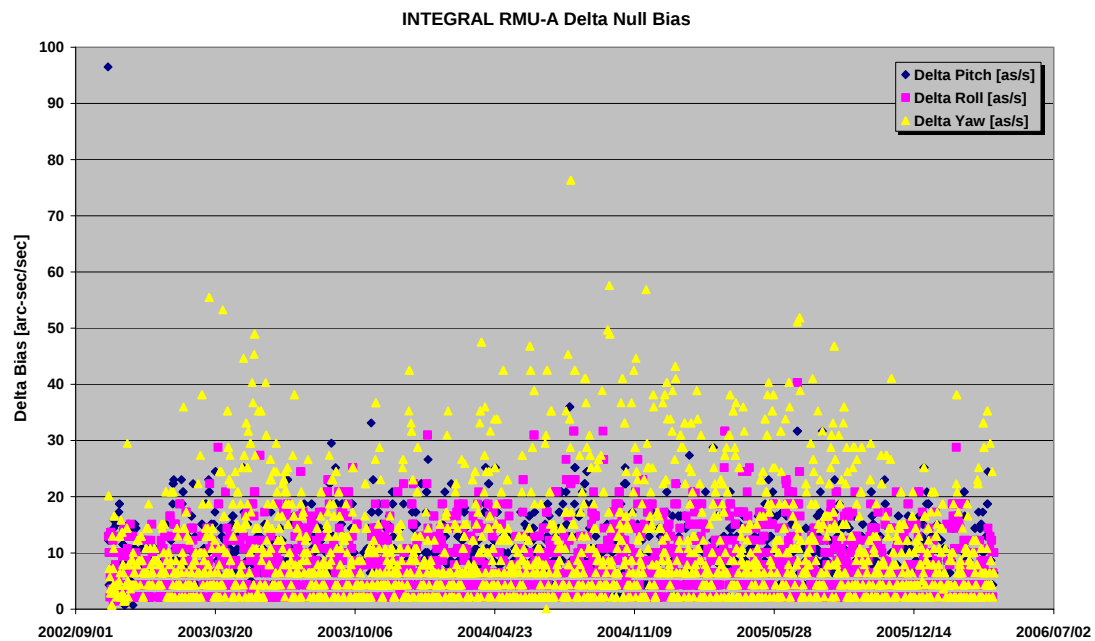


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 07/04/2006 is reported in the plot below.



The RMU-A delta null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 07/04/2006 is reported in the plot below.



01/04/06 (Day of Year 091, Revolution 423)

Nothing to report

02/04/06 (Day of Year 092, Revolution 423)

Nothing to report

03/04/06 (Day of Year 093, Revolution 423-424)

Nothing to report

04/04/06 (Day of Year 094, Revolution 424)

Nothing to report

05/04/06 (Day of Year 095, Revolution 424)

Nothing to report

06/04/06 (Day of Year 096, Revolution 424-425)

Nothing to report

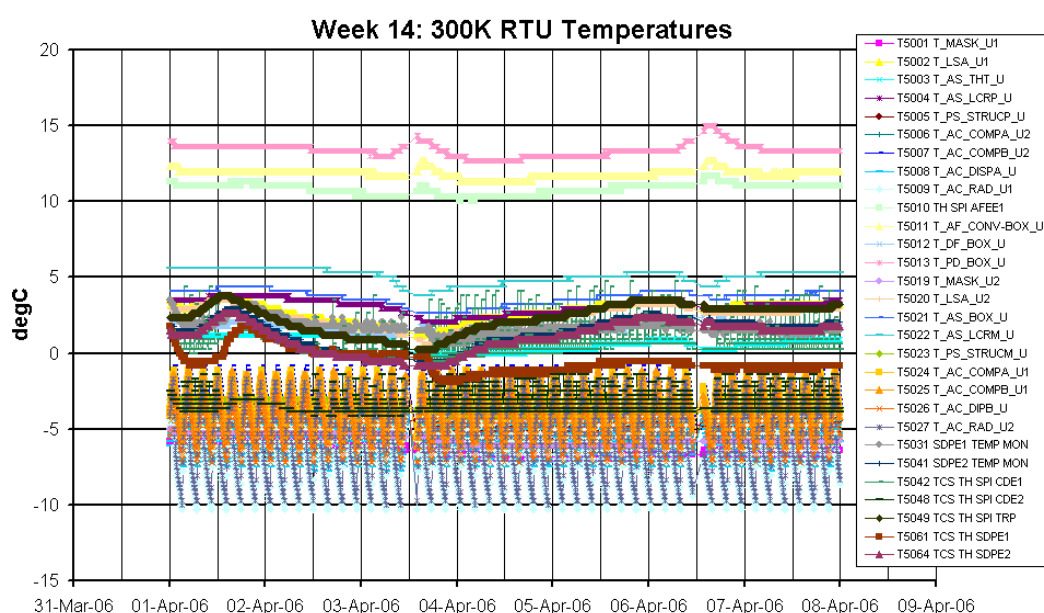
07/04/06 (Day of Year 097, Revolution 425)

Nothing to report

8.3.2 SPI Operations

Unit Temperatures:

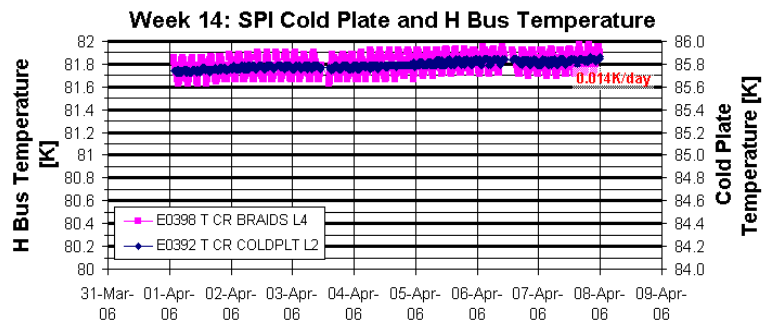
All the equipment temperatures are inside the operational limits. The following plot shows their evolution along the reporting period.



Stirling Compressors and Cryostat:

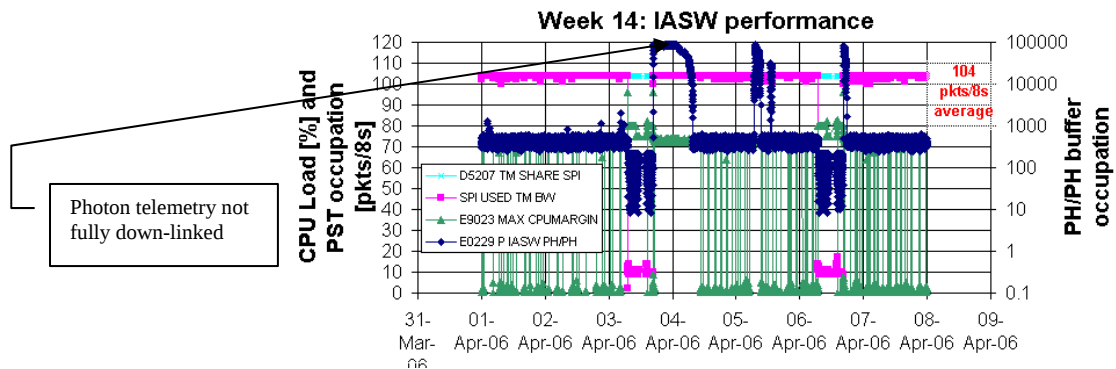
The performance of the compressors is nominal. The cold plate temperature was maintained at 85K $\pm$ 1K showing the expected positive drift.

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



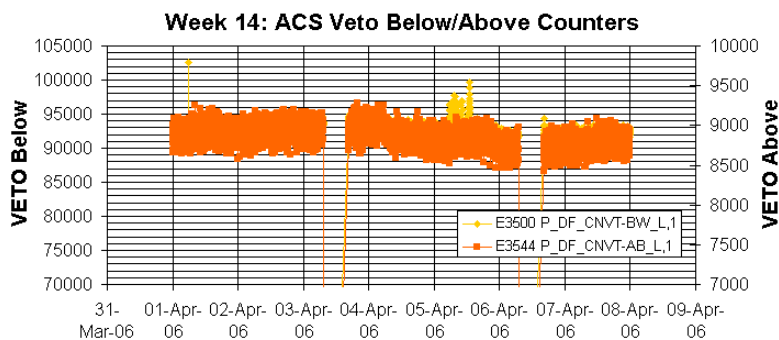
DPE & IASW:

The Iasw performance is nominal. The current IASW version installed is 432. The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



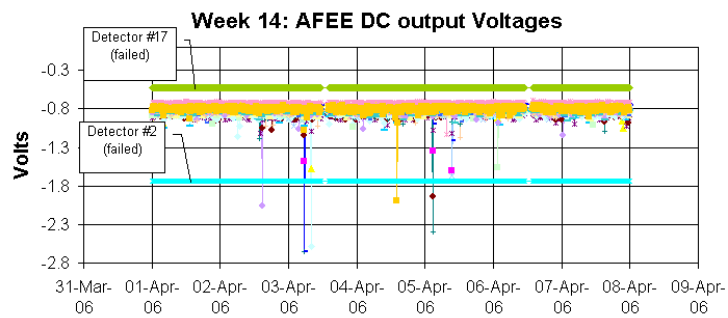
ACS:

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 AFEE and the detectors is nominal, except for detector #15, which shows a degraded energy resolution. The anomaly has been recorded in the ESOC Anomaly Report and Tracking System (ARTS) as INT_SC-140. The following plot shows the dc voltage offset of the detector channels during the reporting period. The values are nominal. Detector #2 is failed since 06.12.2003 and detector #17 is failed since 17.07.2004.

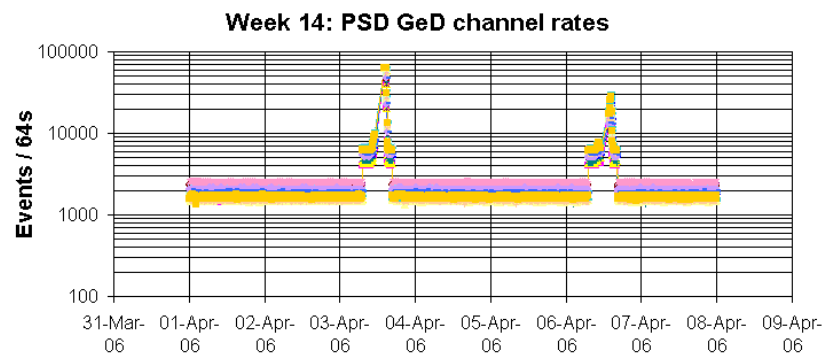


DFEE:

The performance of the unit is nominal.
 Plots are not available for the reporting period.

PSD:

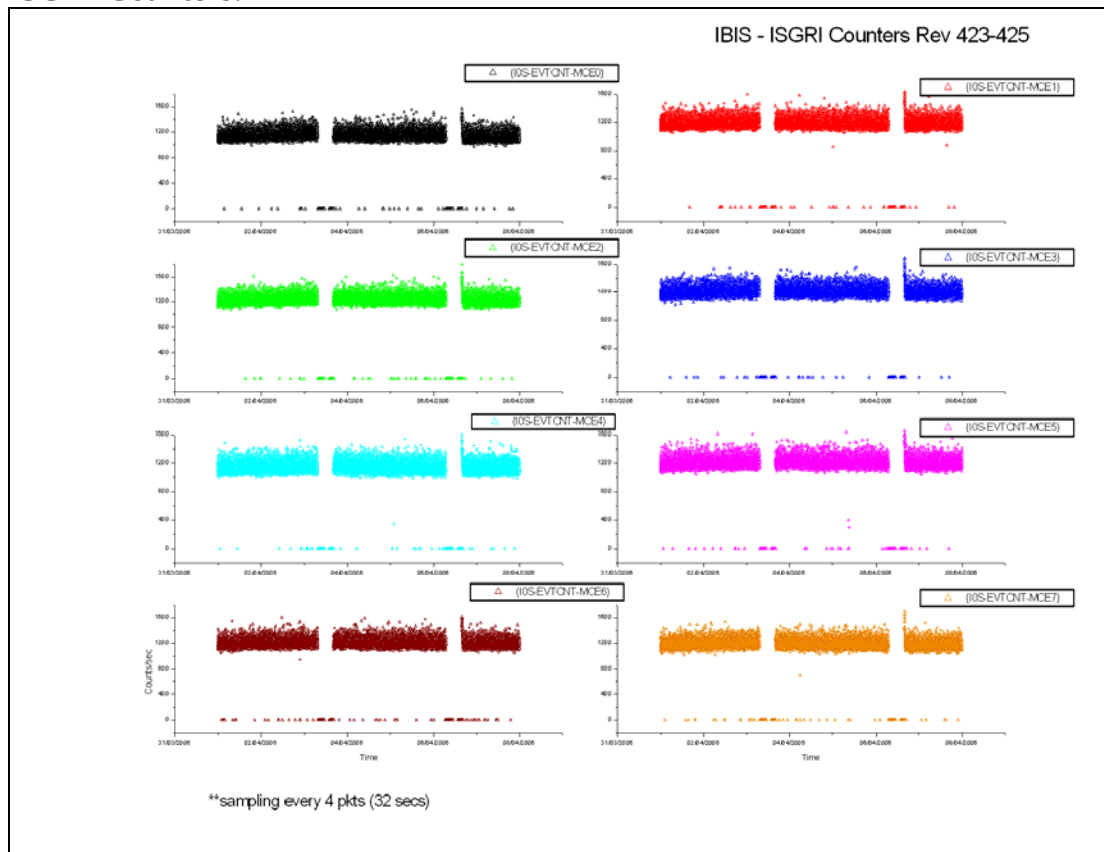
The performance of the unit is nominal.
 The following plots show the PSD channel rates during the reporting period.



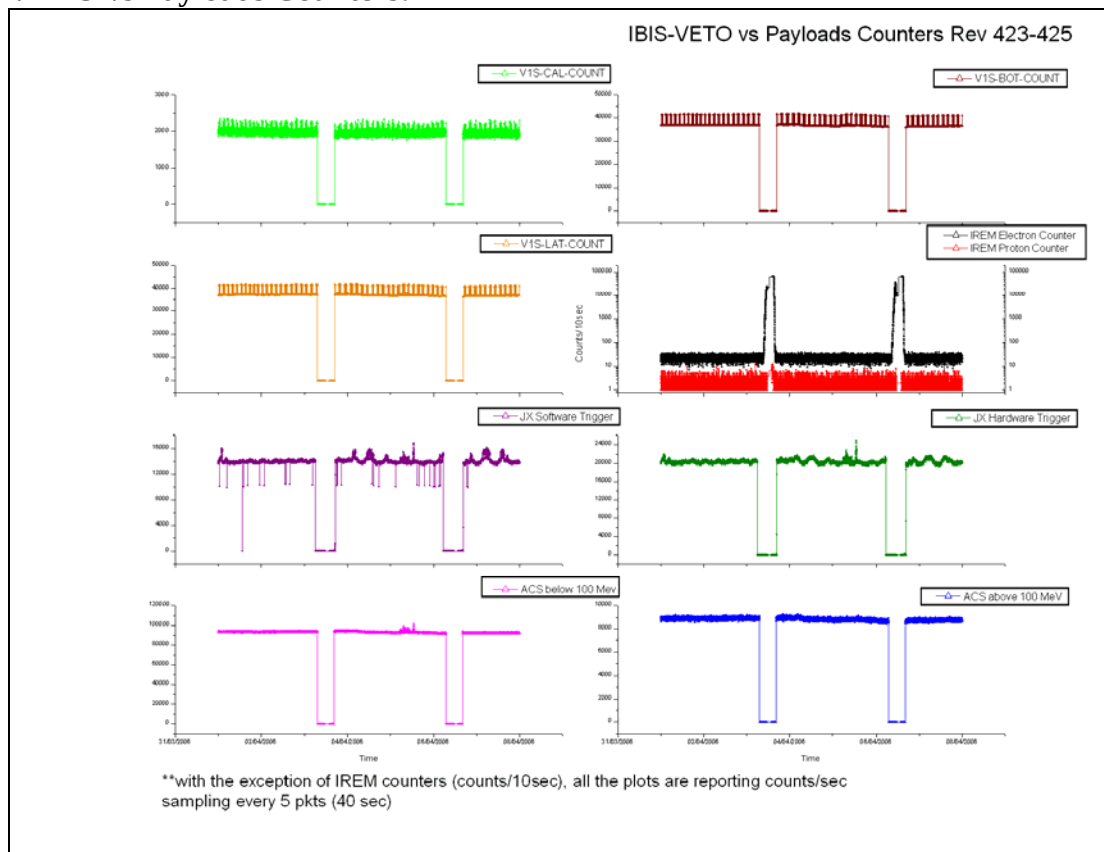
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

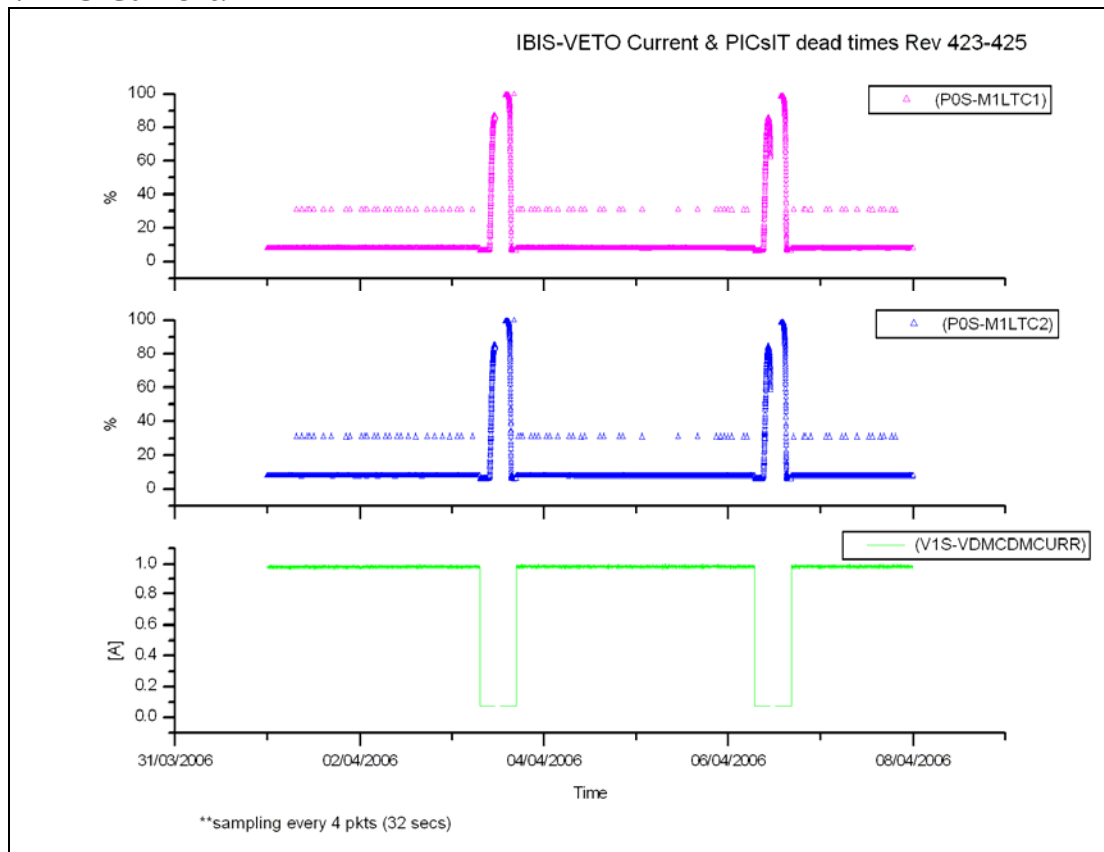


VETO vs Payloads Counters:

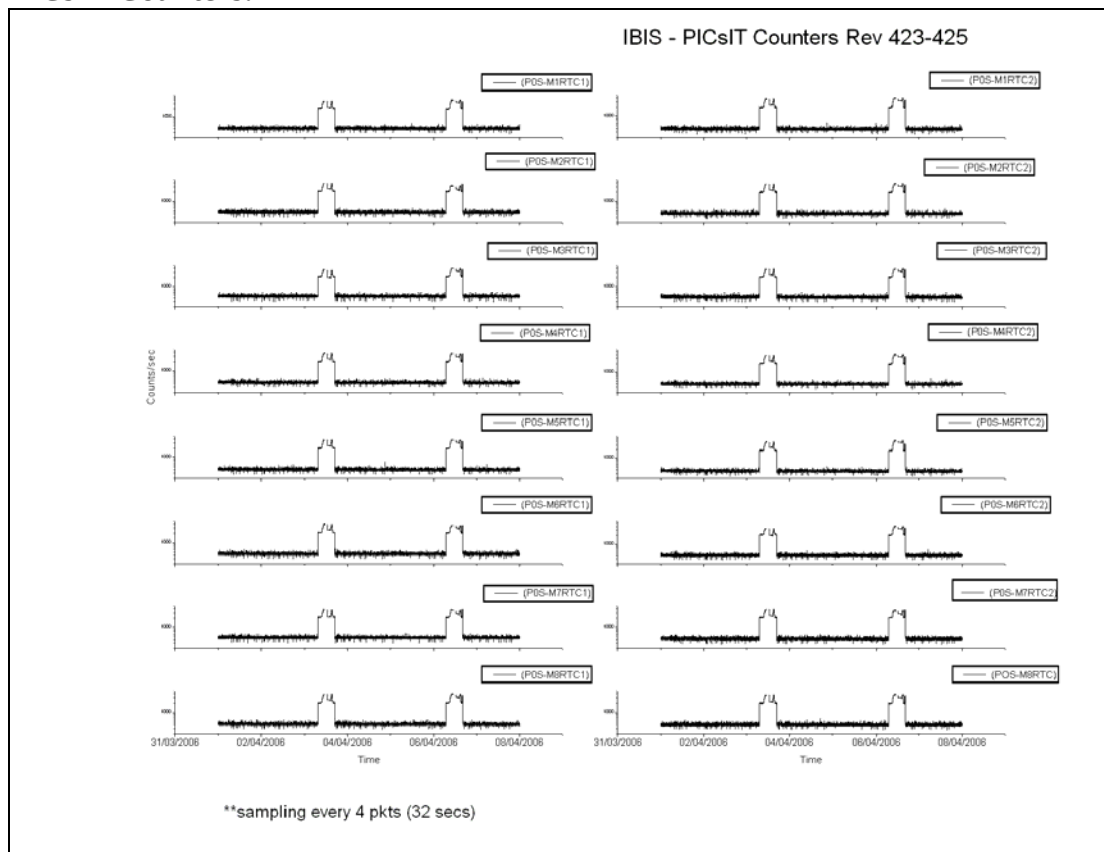


The week was characterised by low radiation.

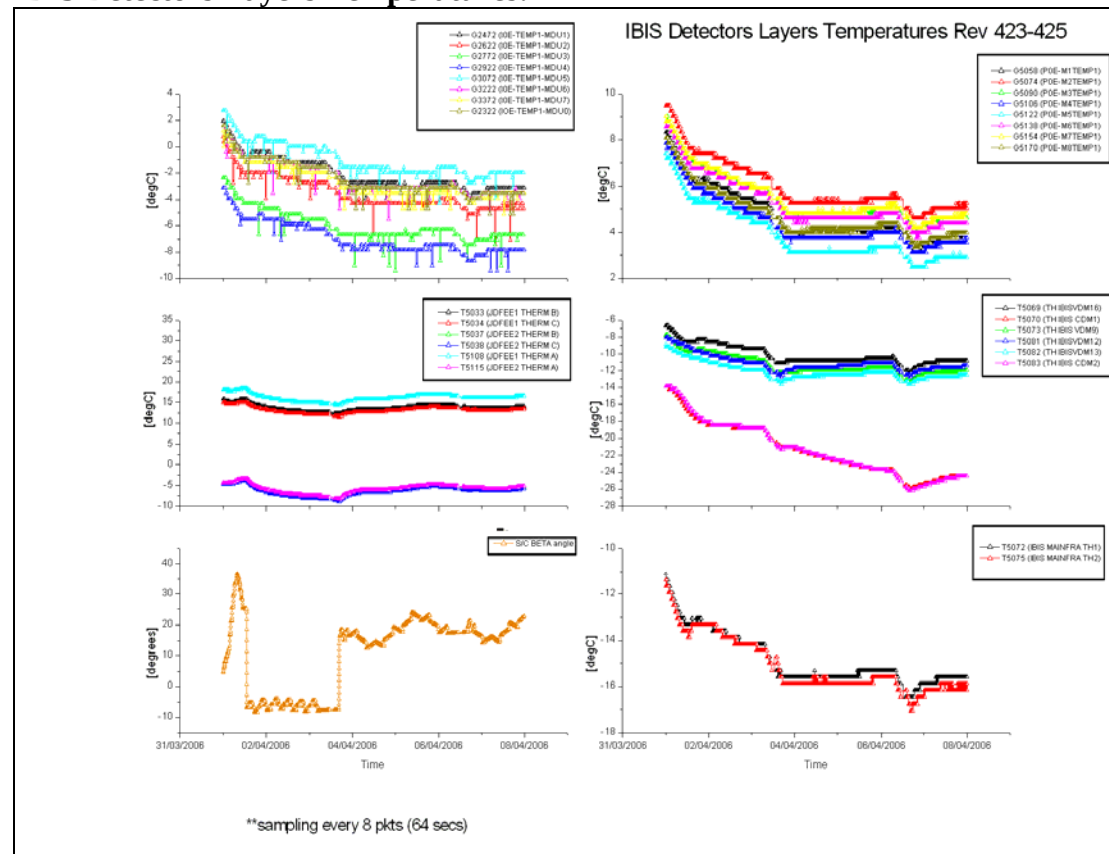
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

DoY 2006.093 (03/04/2006):

At 07:17Z, TM parameter G8015 was reported Out Of Limit high. It went back inside limit at 16:47Z. As this happened inside the radiation belts (following VETO Stand-By mode), according to V-VLT-1 no action was taken.

Inside the radiation belts, TM parameter G5027 (P0S-M6RTC1) was toggling OOL high. According to P-CNT-1, no action was taken.

At 16:23Z, TM parameter G2056 (I0E-OVFWPXADD-M4) failed SCC and back. At 16:24Z, TM parameter G2014 (I0E-OVFWPXADD-M1) failed SCC and back. According to I-OVF-1, as this happened inside radiation belts, no action was taken.

DoY 2006.096 (06/04/2006):

At 06:58Z, TM parameter G8015 was reported Out Of Limit high. It went back inside limit at 16:28Z. As this happened inside the radiation belts (following VETO Stand-By mode), according to V-VLT-1 no action was taken.

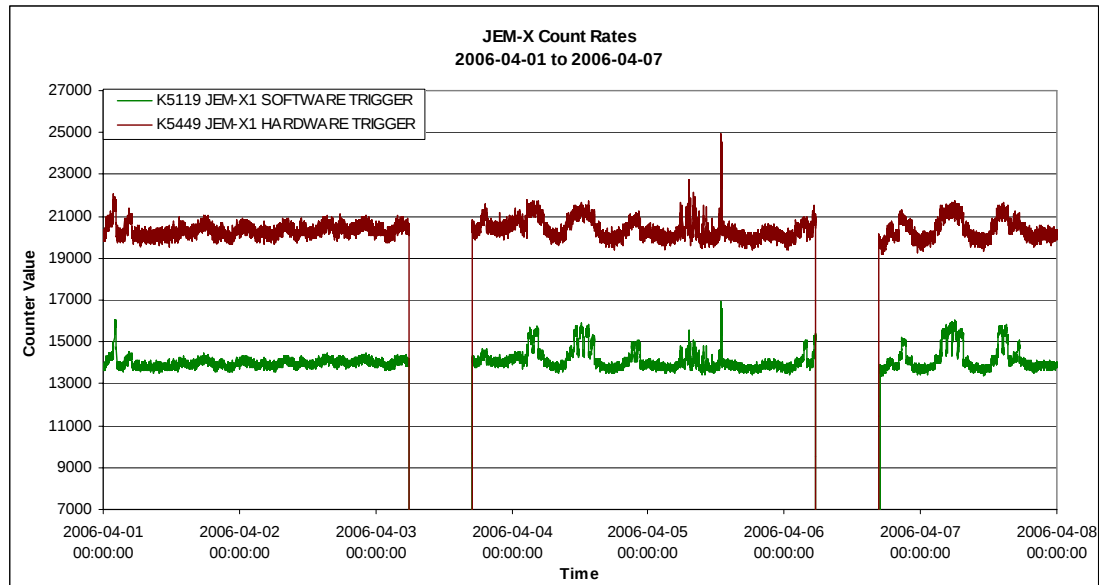
Inside the radiation belts, TM parameters G5002 (P0S-M1RTC1), G5003 (P0S-M1RTC2), G5012 (P0S-M3RTC1), G5018 (P0S-M4RTC2), G5023 (P0S-M5RTC2)

and G5028 (P0S-M6RTC2) were toggling OOL high. According to P-CNT-1, no 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.

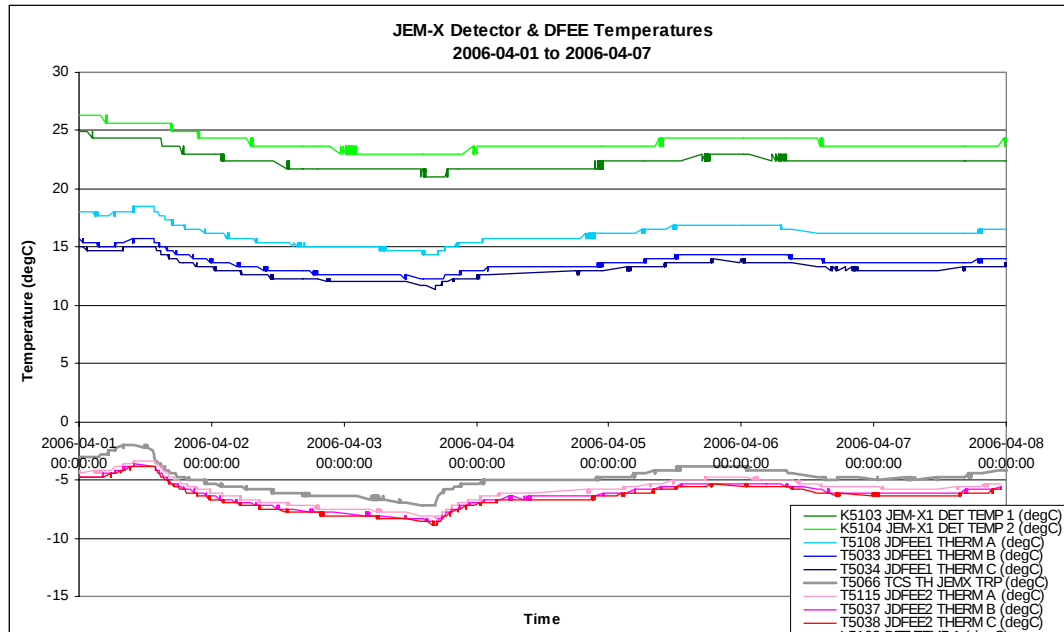


8.3.4.2 JEM-X Temperatures

JEM-X Detector and DFEE temperatures, along with the temperature on the detector bench between the two units, over the reporting period are displayed in the following graph².

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

2006-04-01 (DOY 091, Rev 423) to 2006-04-07 (DOY 097, Rev 425)

Nothing to report

8.3.5 OMC Operations

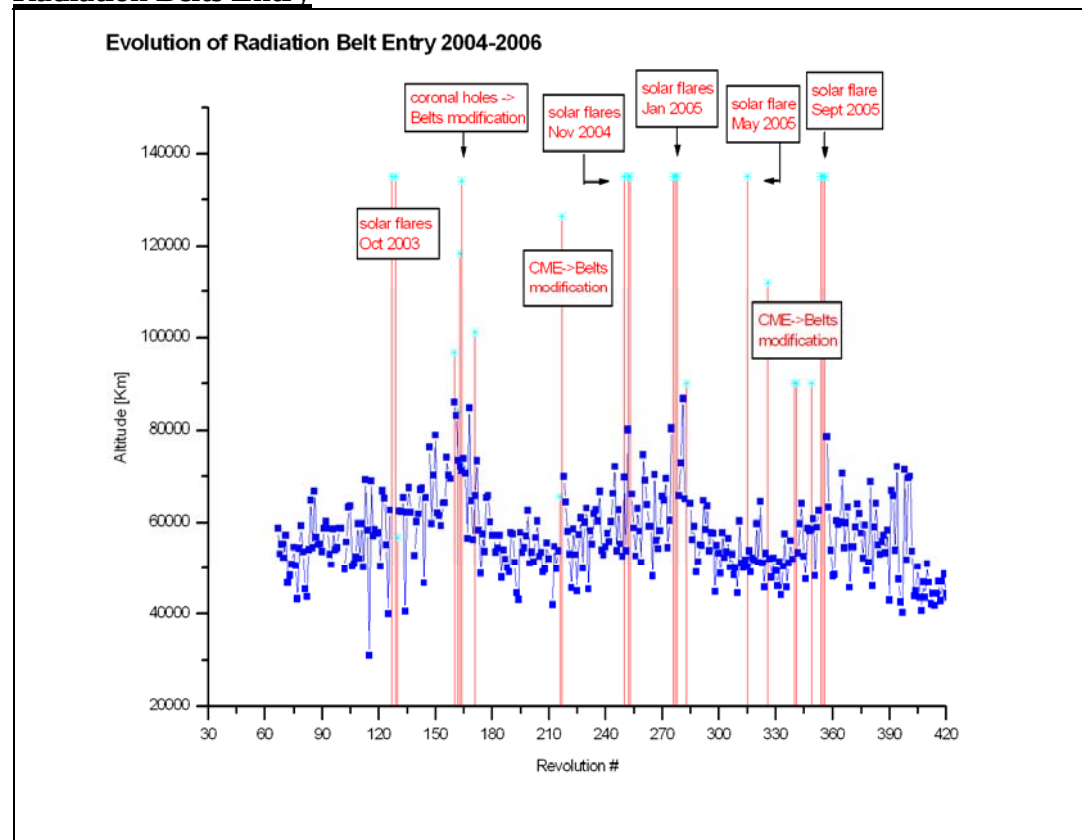
2006-04-01 (DOY 091, Rev 423) to 2006-04-07 (DOY 097, Rev 425)

Nothing to report

On DoY 093 at 07:17:21 and DoY 096 at 06:58:49 OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



IREM daily report

Nothing to report.

Electron Belts

REV	S/C BCPKT (electron)	Electron CUT-OFF Observed Entry/Exit	Observed Entry/Exit Altitude [Km]	Electron CUT-OFF Predicted Entry/Exit	Predicted Entry/Exit Altitude [Km]
423	RAD_ENTR R 2006-04-03T07:17:17Z	2006-04-03 09:43:52	39813.7	2006-04-03 08:43:58	48033
424	RAD_EXIT R 2006-04-03T16:35:05Z	2006-04-03 15:54:56	<<38066.9	2006-04-03 15:53:58	34188
424	RAD_ENTR R 2006-04-06T06:58:41Z	2006-04-06 08:53:36	<44939.9	2006-04-06 08:27:33	48139
425	RAD_EXIT R 2006-04-06T16:16:21Z	2006-04-06 15:38:24	<<40024.3	2006-04-06 15:37:33	34121

Reference

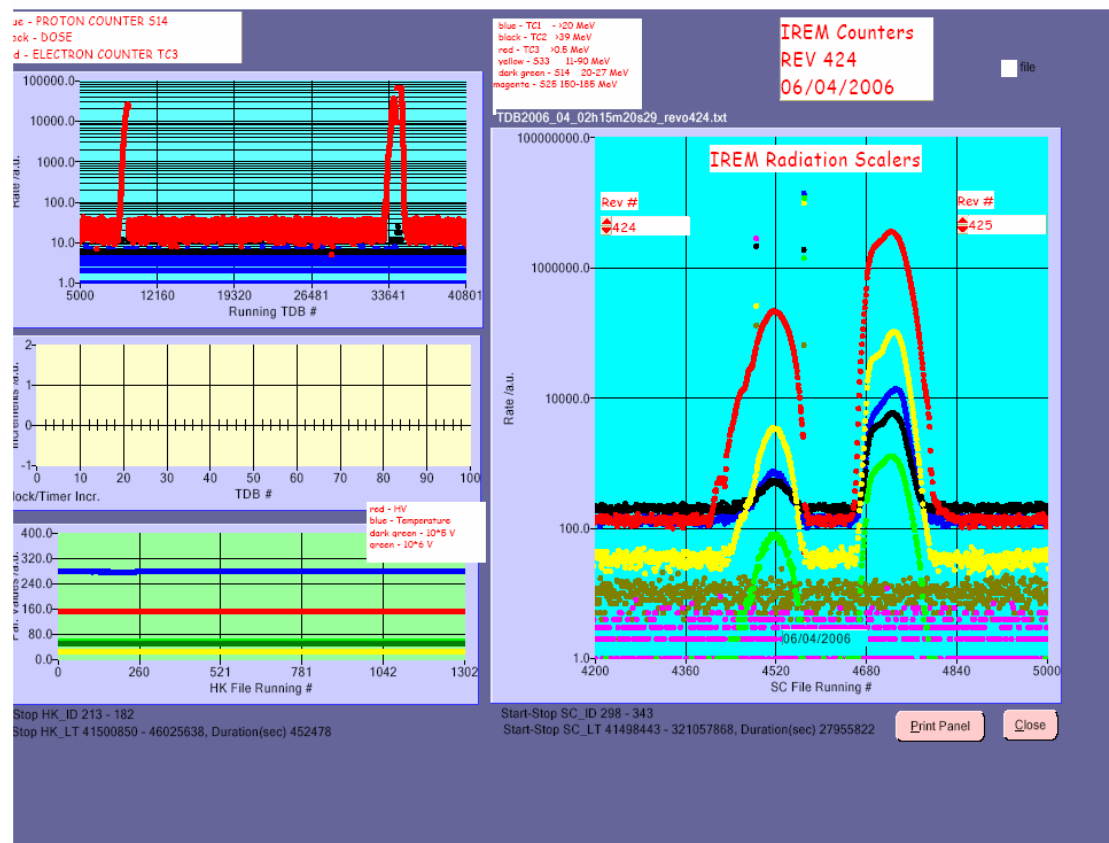
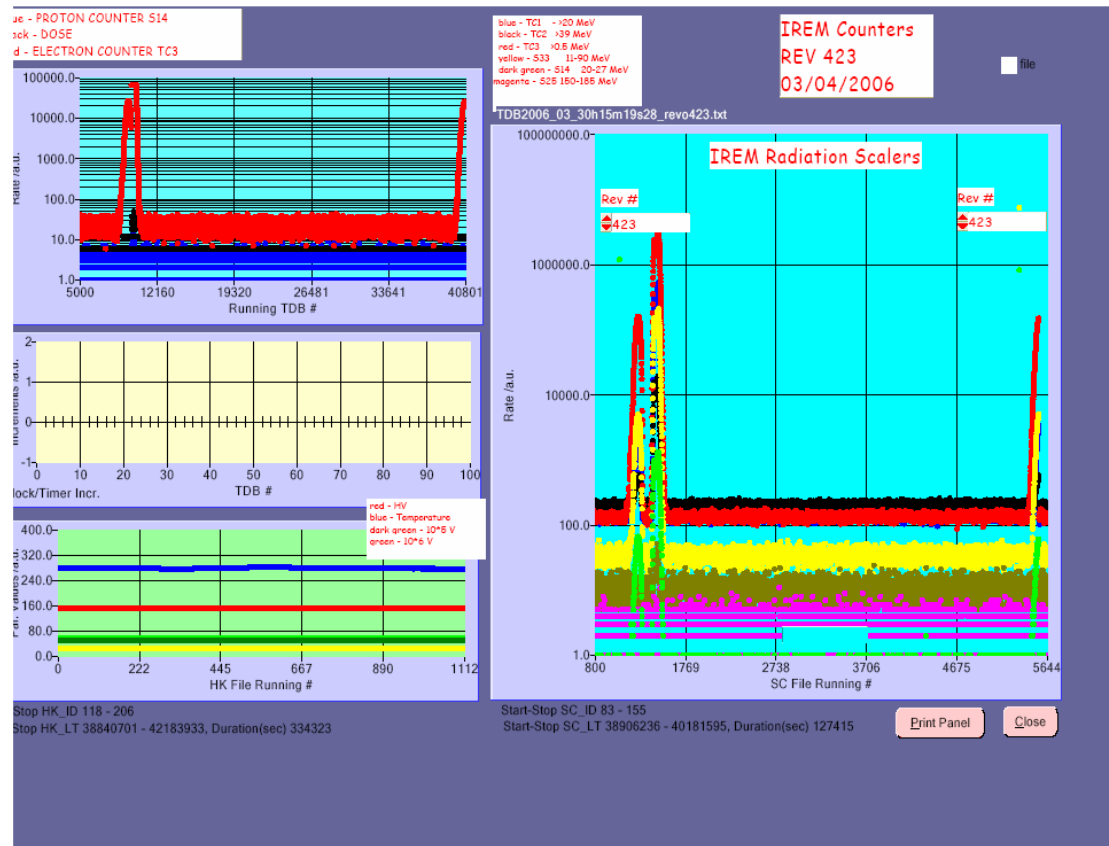
Very small error vs reference (less than 10 minutes)

Small error vs reference (between 10 and 30 minutes)

Large error vs reference (more than 30 minutes)

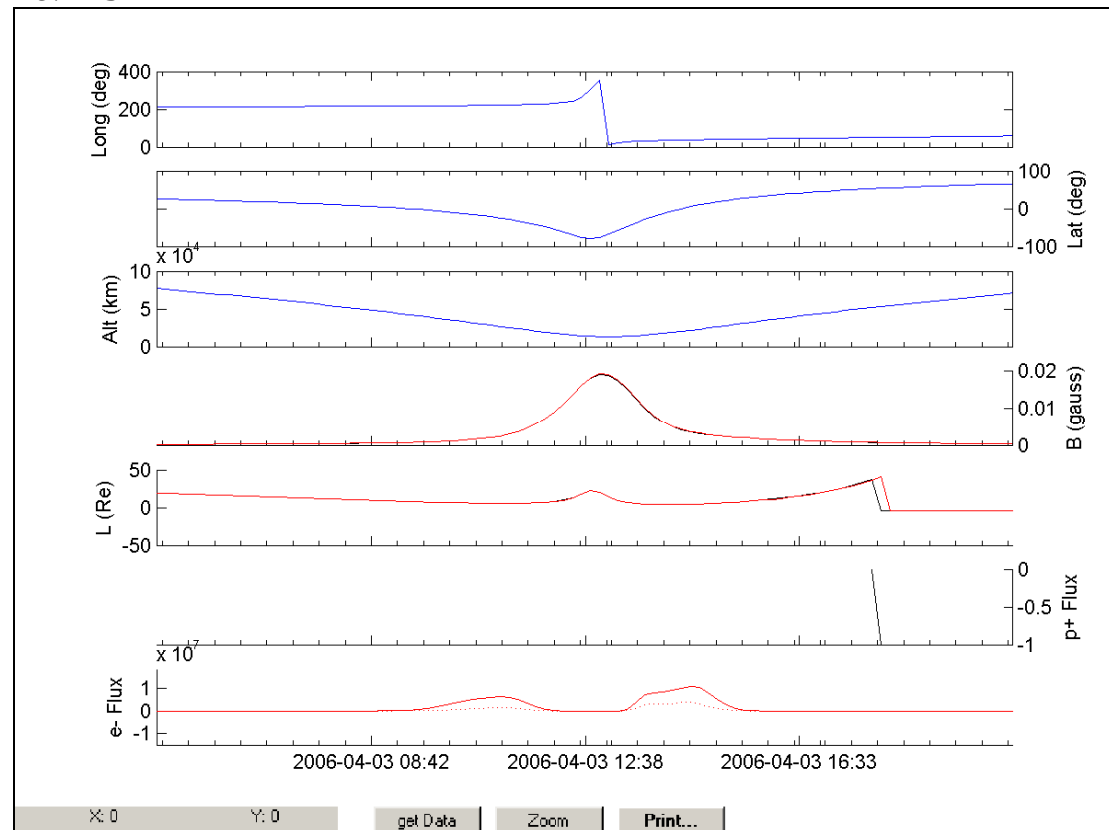
Radiation Spike

IREM radiation counters:

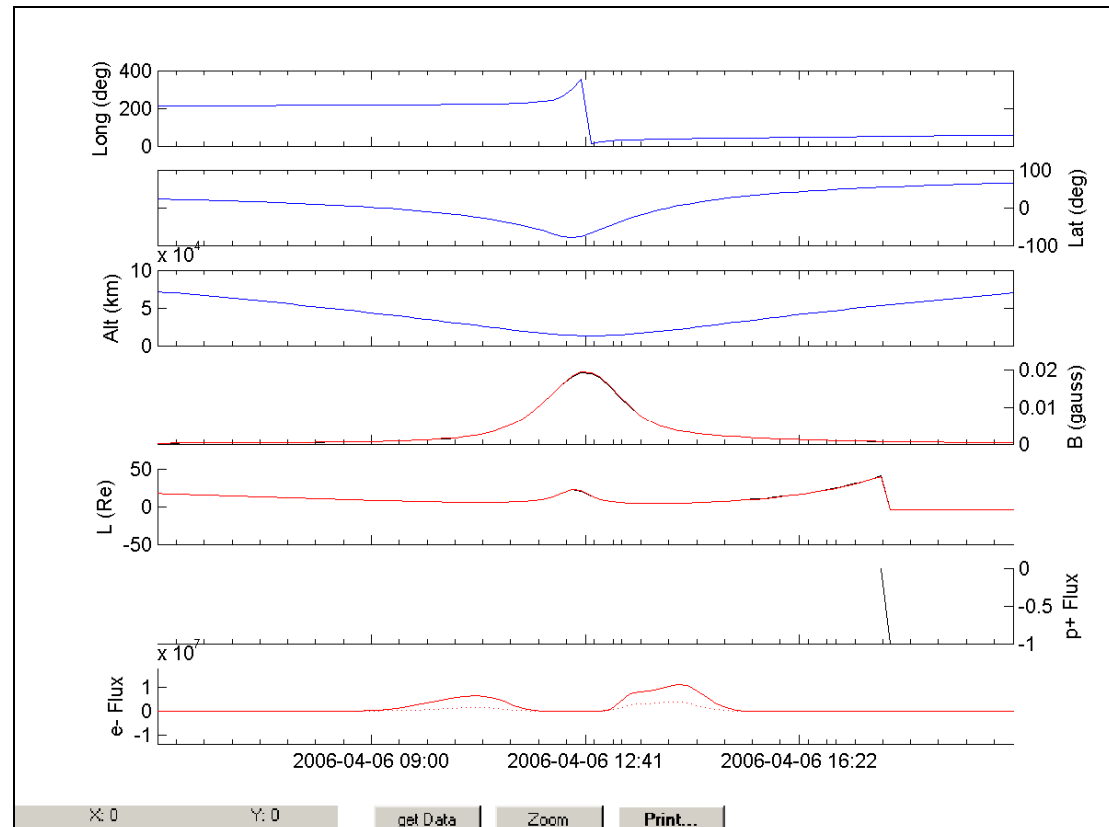


IREM Predicted Radiation Belt Passages:

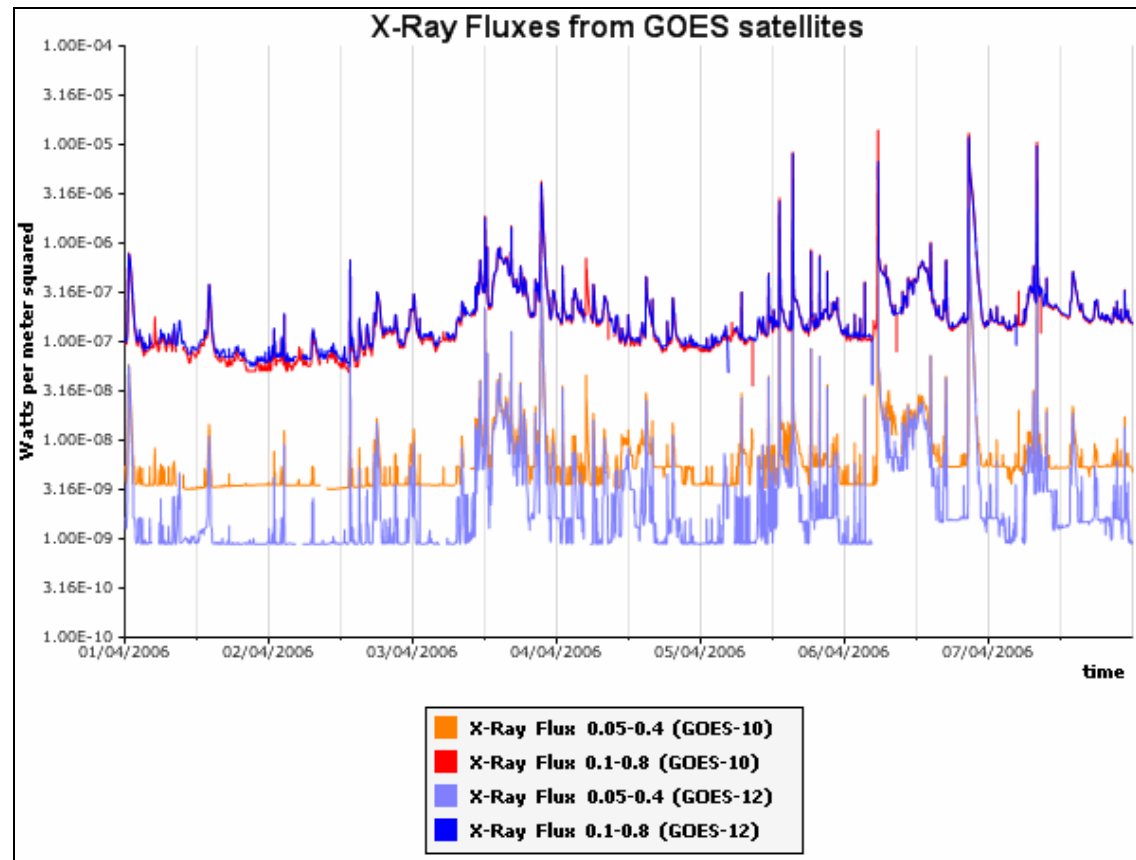
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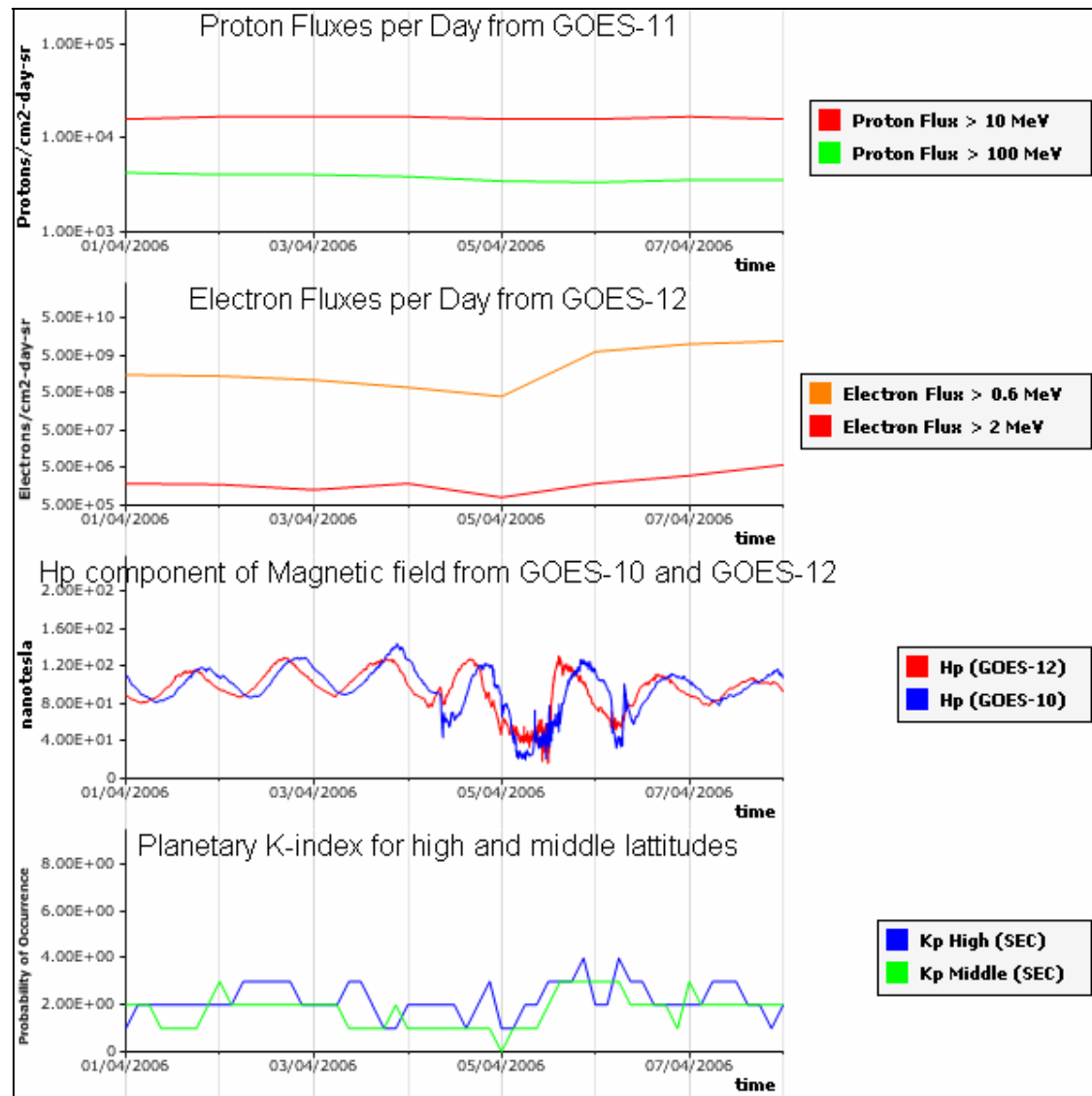
Rev 424



SEC-GOES Observed Particles Fluxes (using SEIS/RAT tool):



X-Ray fluxes start to be significant over 10^{-5}W/m^2 (corresponding to M-class flares). Above 10^{-4}W/m^2 , they correspond to strong X-class flares.



Proton and electron flux are rather low, reporting no high radiation background. Hp component of the Geomagnetic Field is essentially parallel to the Earth's rotation axis. A drop near 0 nT is associated with a significant variation in the magnetic field. Kp index is based on ground magnetometers. Kp ≥ 5 features storm-level geomagnetic activity.