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

INTEGRAL
Mission Report

INT-MOC-SYS-RP-1001-OPS-OF

No. 171
Week 52

02.01.06

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 24.12.05 until 30.12.05 (both dates inclusive) and covers the revolutions 391 and 392.

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 Cas A /Tycho (RA 23:51:43.00; DEC +62:03:55.0) and the Galactic Plane. The activities consisted of raster dithering and GPS 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.

The LOBT wrap-around occurred on DoY 359 at 03:42:17Z.

3 slews (2 OSL, 1 CSL) were not executed from the Timeline during this period due to a problem on the IMCS-A chain and on search and track process.

The fuel consumption over the period between 15/11/2005 and 28/12/2005 was 0.1352 kg. The remaining propellant is in the order of 157.3636 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.

The LOBT wrap-around occurred on DoY 359 at 03:42:17Z. INT-OR-0232 was manually executed around this time.

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

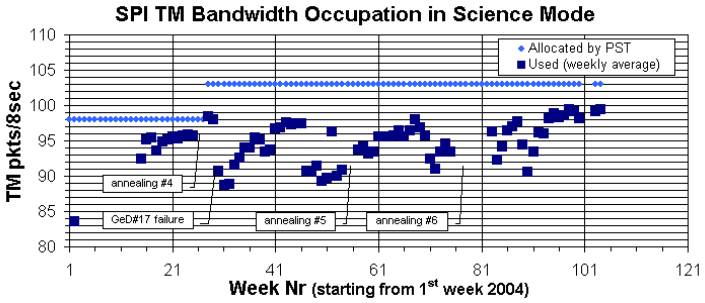
3.2.1 SPI

The overall status of the instrument is nominal.

During science operations, the instrument was kept in photon-by-photon mode, with spectra TM enabled, an assigned TM bandwidth in the science observation windows of 103 pkts/cycle and an average occupation of 99.5 pkts/cycle.

The Stirling compressors are working well, maintaining the detector cold-plate temperature within 85+/-1K.

The following plot shows the TM bandwidth occupation information.



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

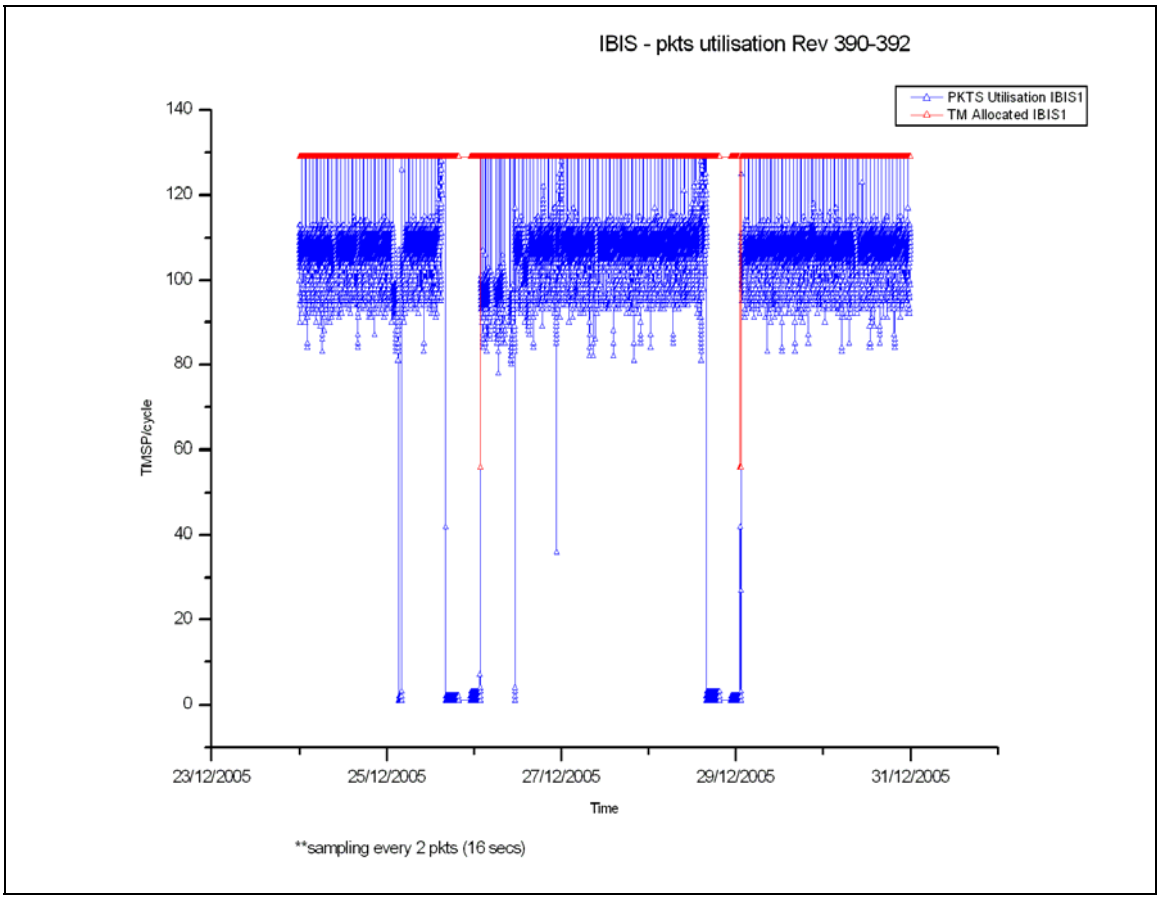
3.2.2 IBIS

The Overall status of the unit is Nominal.

The LOBT wrap-around was performed on DoY 359 at 03:41:17Z.

During the reporting period, the PST allocation to IBIS was 129 TMPS/cycle. The IBIS mean bandwidth utilisation during the observation period was 107.94 TMPS/cycle, up 0.64 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 during science observations with a TM allocation of 8 packets/cycle 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.

During this reporting period, 138 of the 141 planned science pointings for OMC were executed nominally, two were lost, and one was delayed by 20 minutes.

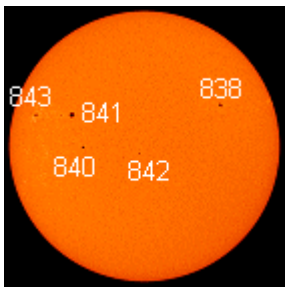
Note: Some more information concerning the OMC operations is provided in the Appendix Section 8.3.5.

3.2.5 IREM

The overall status of the unit is nominal.

Solar Activity
The observation period was characterised by low solar activity.

The sun was quiet this week. Several sunspots were present but did not pose any threat of Solar Flare.



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 performance of the Operational ground facilities was very good this week, 2 pointings were lost, and another pointing was delayed due to ground problems. The overall performance was still above the 95% requirement.

4.1 Mission Operations Centre

The performance of the MOC was good this week, the CDP task crashed, which caused the loss of 2 pointings, and an AOCS command failed release due to the static PTV no-go, which delayed a third pointing. The overall performance was still above the 95% requirement.

4.2 Ground Stations & Network

The performance of the ground stations and Network was very good this week There were a few instances of bad frames and TM drops, but these had no impact on the mission. The overall performance was well above the 95% requirement.

4.3 Science Ground Segment

4.3.1 ISOC

The ISOC input will be provided next week.

4.3.2 ISDC

Status of ISDC observation processing on 02/01/2006:

- Latest Standard Analysis completed: observation 03200200011 (GRS 1915+105 , Revolution 379) on 02/01/2006

- Latest products archived: observation 03200200005 (GRS 1915+105, Revolutions 373) on 02/01/2006

- Latest observation products sent to the observer: observation 03200930001 (GX 17+2, Revolution 369-370) on 02/01/2006

5 Special Events

6 Anomalies

There were a number of problems that impacted the operations:

- On DoY 360, at 04:32, the CPD-TM task within the imcs crashed. The impact was the loss of pointings 03910005 and 03910006.
- At 13:19, an AOCS command failed the PTV, and was not released, the consequent recovery delayed the next pointing (03910016) by 20 minutes.

No anomaly reports were entered into the ARTS system this week.

7 Future Milestones

Preparation is on-going for the earth observation, currently planned to take place in January.

The upgrade of the IMCS has been delayed for incorporation of an urgent fix which has become available from infrastructure, new release date will probably be early January depending upon the time taken to integrate and test this patch.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 391

The observations in revolution 391 continued with raster dithering observations of the Cas A / Tycho supernova (RA 23:51:43.00; DEC +62:03:55.0) lasting ~49.6 hours and a GPS survey lasting ~6.1 hours.

Revolution 392

The observations in revolution 392 continued with raster dithering observations of the Cas A / Tycho supernova (RA 23:51:43.00; DEC +62:03:55.0) lasting ~58.5 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 was IBIS 129; SPI 103; JEM-X1 8; JEM-X2 1; OMC 5.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

```
2005-12-17T00:32:06.000Z     157.5687    F   Automatic TM processing.
2005-12-17T09:29:11.000Z     157.5572    F   Automatic TM processing.
2005-12-18T10:47:14.000Z     157.5481    F   Automatic TM processing.
2005-12-19T19:42:38.000Z     157.5339    F   Automatic TM processing.
2005-12-20T00:15:42.000Z     157.5328    F   Automatic TM processing.
2005-12-21T10:23:38.000Z     157.5206    F   Automatic TM processing.
2005-12-22T19:37:02.000Z     157.5064    F   Automatic TM processing.
2005-12-22T23:59:27.000Z     157.4988    F   Automatic TM processing.
2005-12-24T10:07:39.000Z     157.4870    F   Automatic TM processing.
2005-12-25T16:58:54.000Z     157.4676    F   Automatic TM processing.
2005-12-25T23:41:43.000Z     157.4486    F   Automatic TM processing.
2005-12-26T08:42:32.000Z     157.4294    F   Automatic TM processing.
2005-12-27T09:59:39.000Z     157.4121    F   Automatic TM processing.
2005-12-28T19:08:38.000Z     157.3978    F   Automatic TM processing.
2005-12-28T23:25:51.000Z     157.3636    F   Automatic TM processing.

This report was generated  Fri Dec 30 08:00:28 GMT 2005
```

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, 24/12/2005 – 30/12/2005

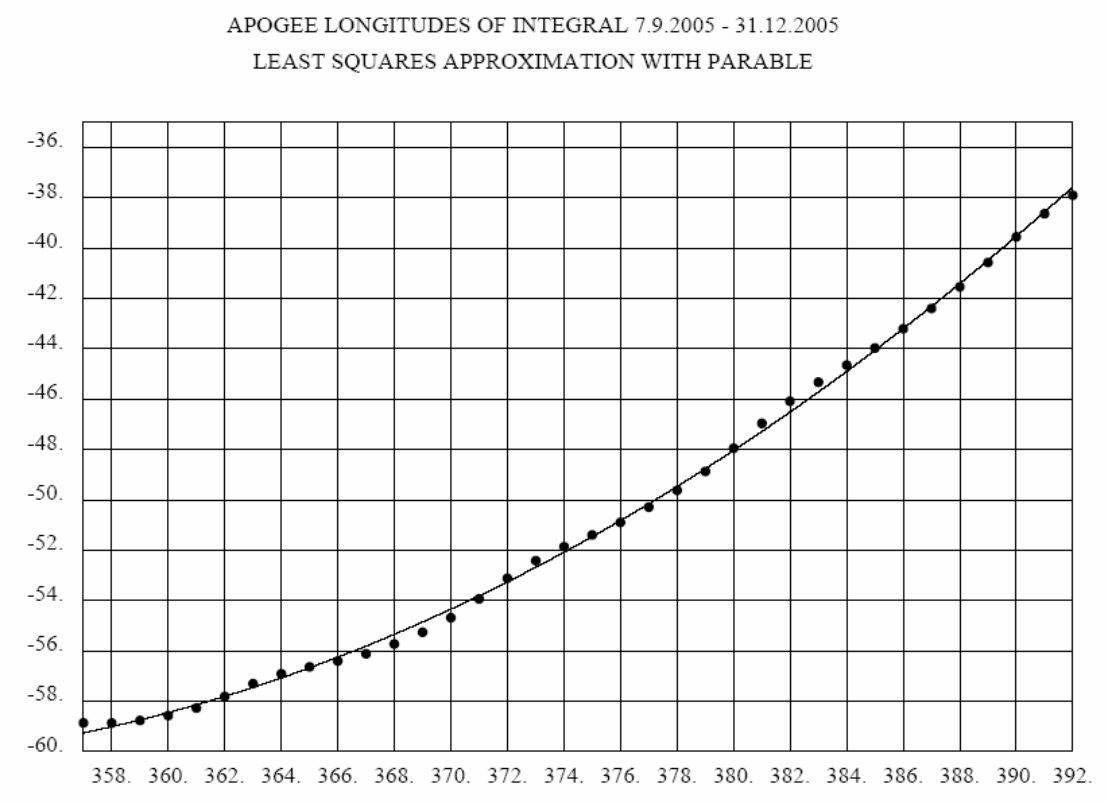
AOCS operations were executed from the Automatic Timeline.

During this period, 42 Open Loop Slews, 108 Closed Loop Slews and 8 Momentum Bias were executed (TL + manual recovery).

3 slews were not executed from the Timeline during this period due to a problem on the IMCS-A chain and on guide star not found during the search and track process.

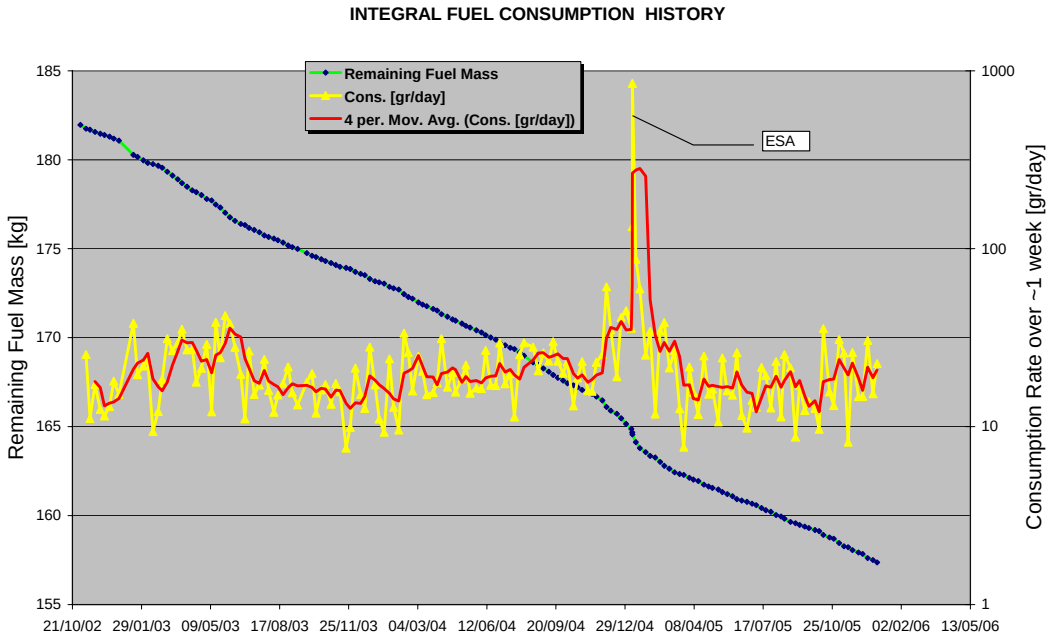
This is equivalent to 1.9 % of the total number of slews planned (151).

Orbit Control

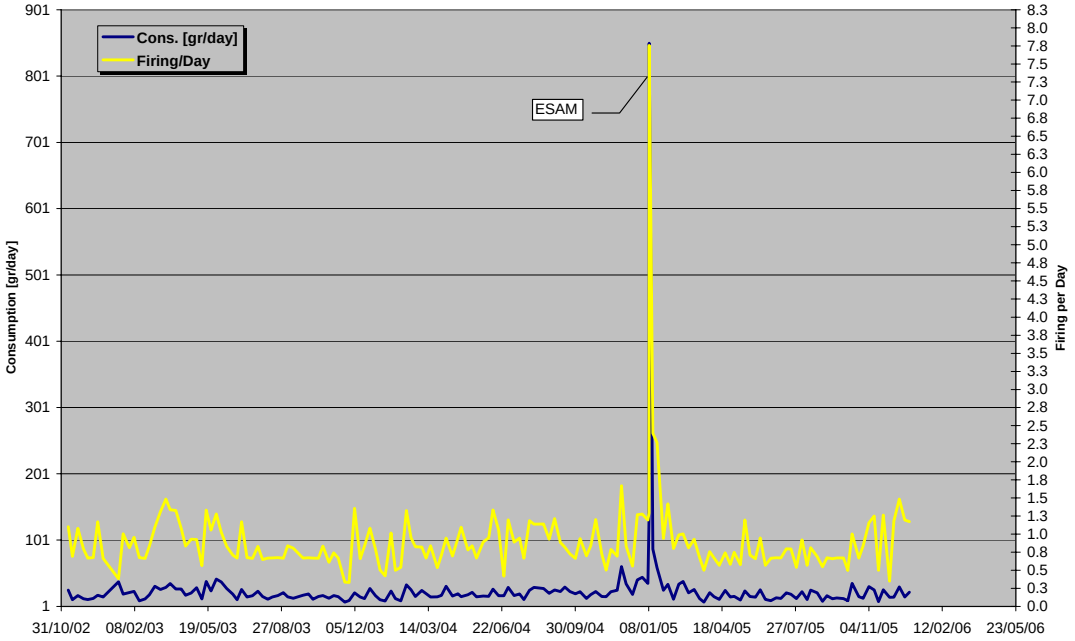


Fuel consumption

The fuel consumption (total, grams/day) over the period between 01/11/2002 and 28/12/2005 is reported in the plot below.

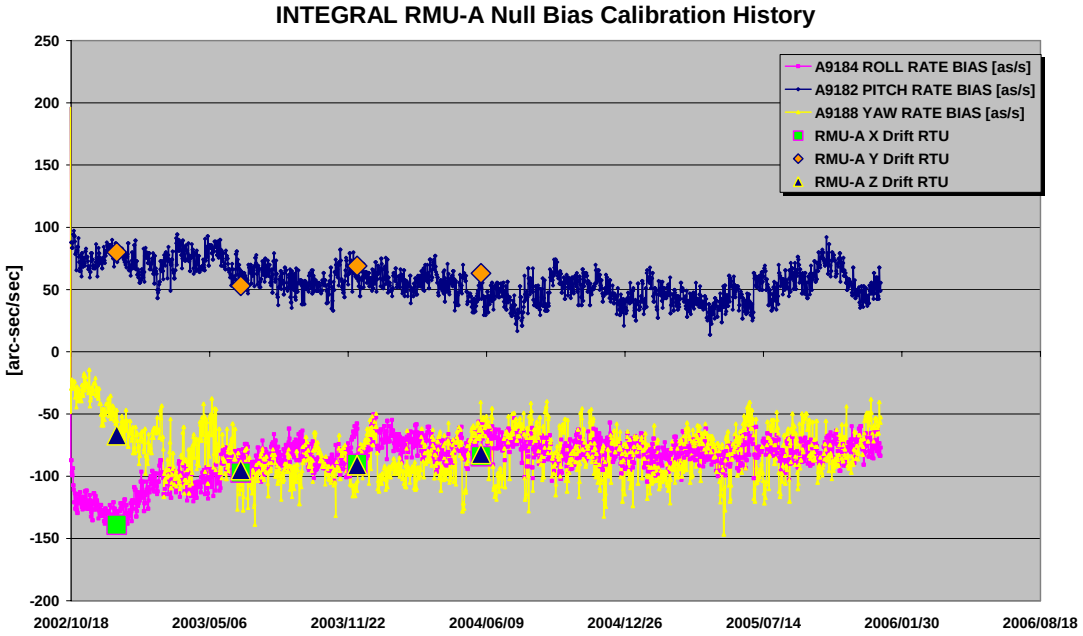


The firing\day over the period between 01/11/2002 and 28/12/2005 is reported in the plot below.

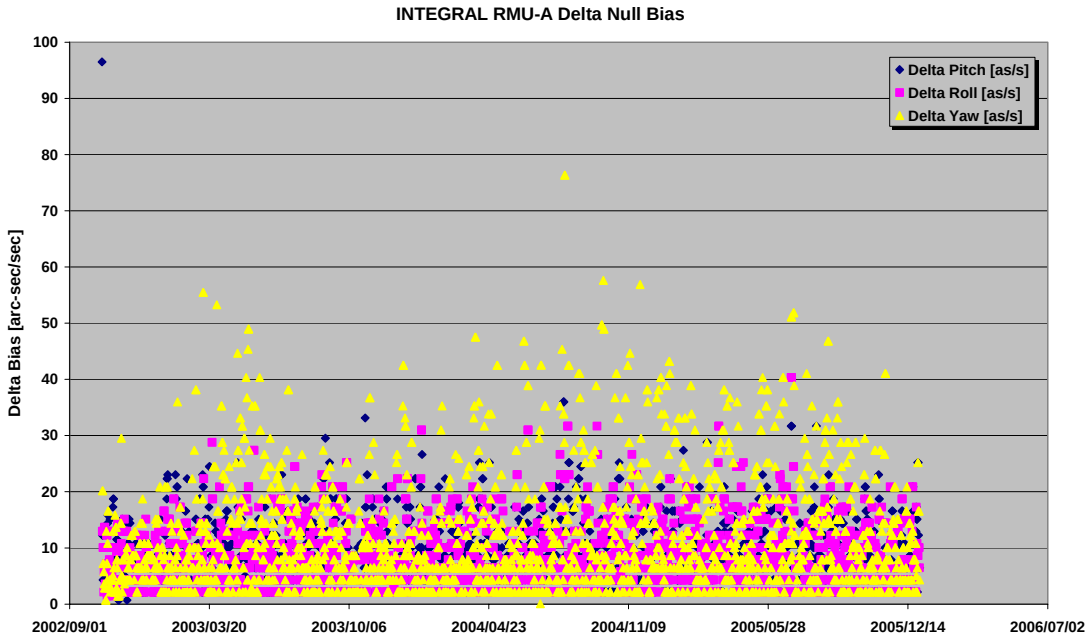


The RMU-A null bias calibration

The RMU-A null bias calibration history, on pitch, roll and yaw channel over the period between 01/11/2002 and 30/12/2005 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 30/12/2005 is reported in the plot below.



24/12/05 (Day of Year 358, Revolution 390)

Nothing to report.

25/12/05 (Day of Year 359, Revolution 390)

LOBT wraparound: the wrap around of the local on-board time occurred at 03:42:17Z; a SATENG window was included in the Timeline to cover the period of the OBT wraparound with some margin and allow time for required operations before and after the wraparound:

2005-12-25T03:20:00Z SATENG_OPEN
2005-12-25T04:00:00Z SATENG_CLOSE

In order to prevent any possible problems was requested to report and reset the AOCS OEM buffer (as per FCP_AOC_0615).

26/12/05 (Day of Year 360, Revolution 390-391)

Slews missed from the Timeline: Due to a problem occurred on IMCS-A chain (CPD_TM task reporting problem and therefore restarted, see detailed problem report in section 6), the slew ID 0391005 failed release.

The AOCS s/s was disabled in TL at 04:38z.

A manual recovery was attempted from attitude of PID 03910004 to the attitude of PID 03910006. The attitude of PID 03910006 was reached in advance wrt the planning. The next slew 03910007 (OSL) was manually updated and executed from the Timeline.

The AOCS s/s was re-enabled in TL at 05:15z.

The following slews were not executed from TL while recovering the AOCS s/s: 0391005(OSL)-06(OSL).

Slew missed from the Timeline: Due to a problem on the S\T process (guide star not found during the search and track process), the slew ID 0391016 failed release.

The Search and track star ID 3666-836 at CCD location [-24647, 1985], was not found and this caused the static PTV NO GO and the failing of the slew sequence release. The star ID 3666-836 was present in the star catalogue but not in TM.

The guide star during the event was Mi 7.15 at CCD location [-757, -12675].

A manual recovery was attempted from attitude of PID 03910015 to the attitude of PID 03910016. The attitude of PID 03910016 was reached 20 mins later wrt the planning. The next slew 03910017 (CSL) was manually updated and executed from the Timeline.

The following slew was not executed from TL while recovering the AOCS s/s: 0391016(CSL).

27/12/05 (Day of Year 361, Revolution 391)

Nothing to report.

28/12/05 (Day of Year 362, Revolution 391)

Nothing to report.

29/12/05 (Day of Year 363, Revolution 391-392)

Nothing to report.

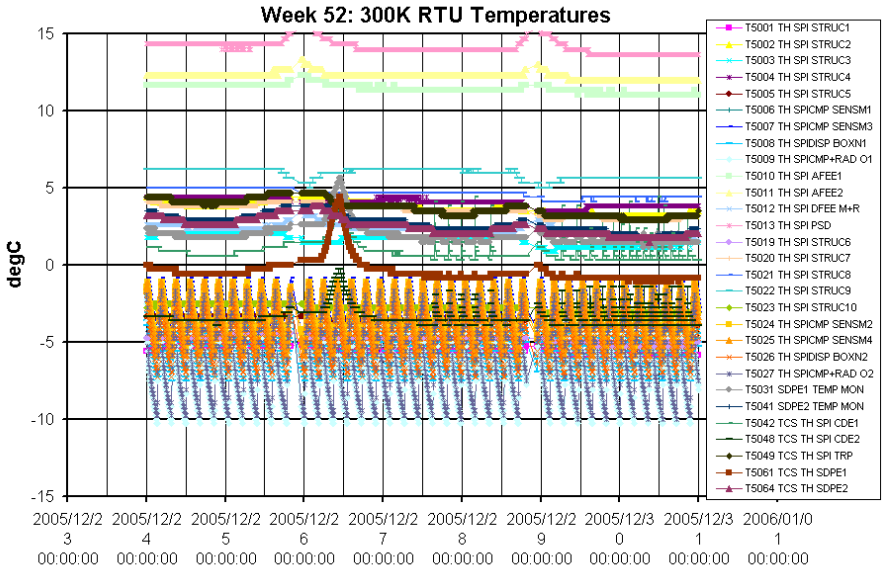
30/12/05 (Day of Year 364, Revolution 392)

Nothing to report.

8.3.2 SPI Operations

Unit Temperatures

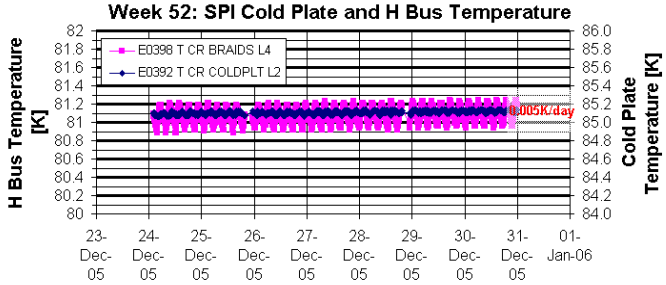
All the temperatures of the equipment are inside the operational limits. The following plot shows their evolution along the reporting period.



Stirling Compressors and Cryostat

The performance of the compressors is nominal. The cold plate temperature was maintained at 85K+/-1K showing the expected positive drift.

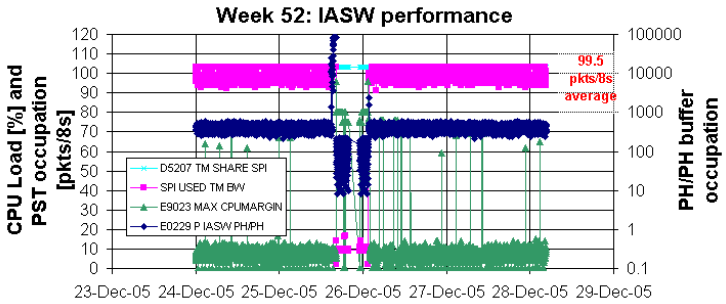
The following plot shows the evolution of the cold-plate and H bus temperatures during the reporting period.



DPE & IASW

The Iasw performance is nominal. The current Iasw version installed is 432.

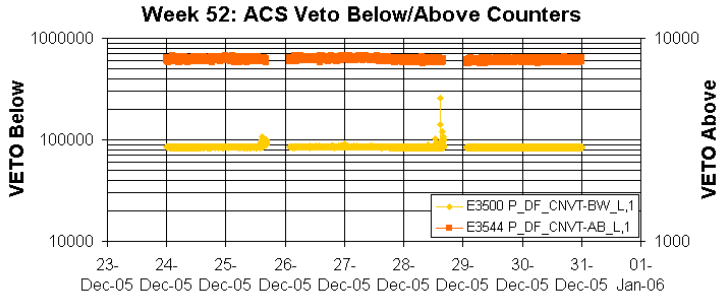
The following plot shows the IASW performance in terms of TM bandwidth, event buffer occupation and DPE CPU load during the reporting period.



ACS

The performance of the ACS is nominal.

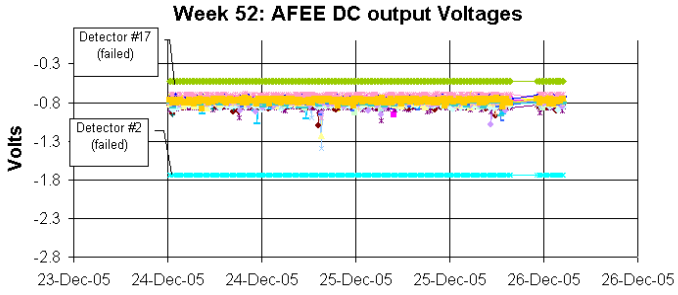
The following plot shows the ACS overall count rate evolution during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



AFEE

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

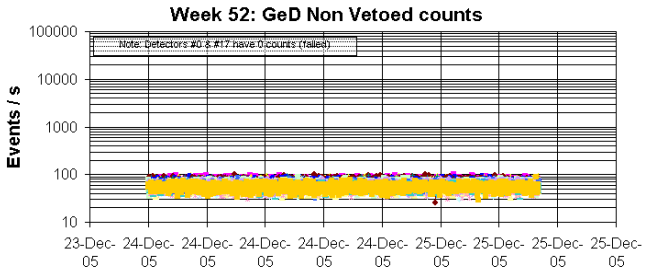
The following plot shows the dc voltage offset of the detector channels during the reporting period.

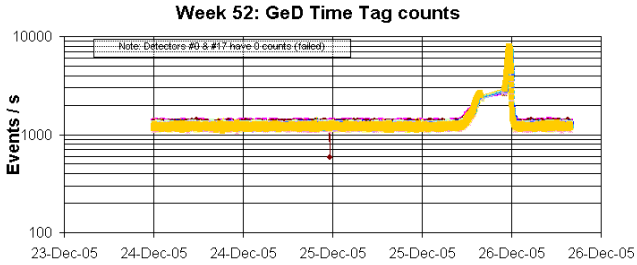


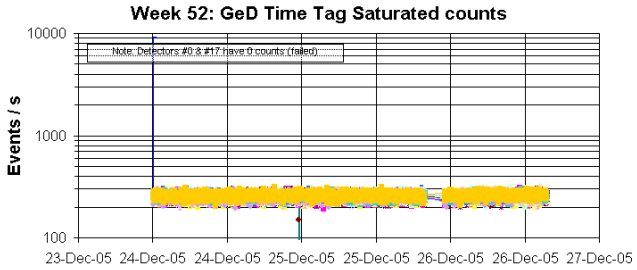
DFEE

The performance of the unit is nominal.

The following plots show the count rates of the detectors during the reporting period (due to problems in the data retrieval tool, some gaps could be present).



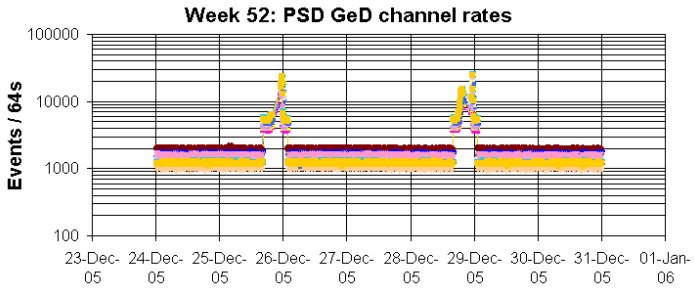




PSD

The performance of the unit is nominal

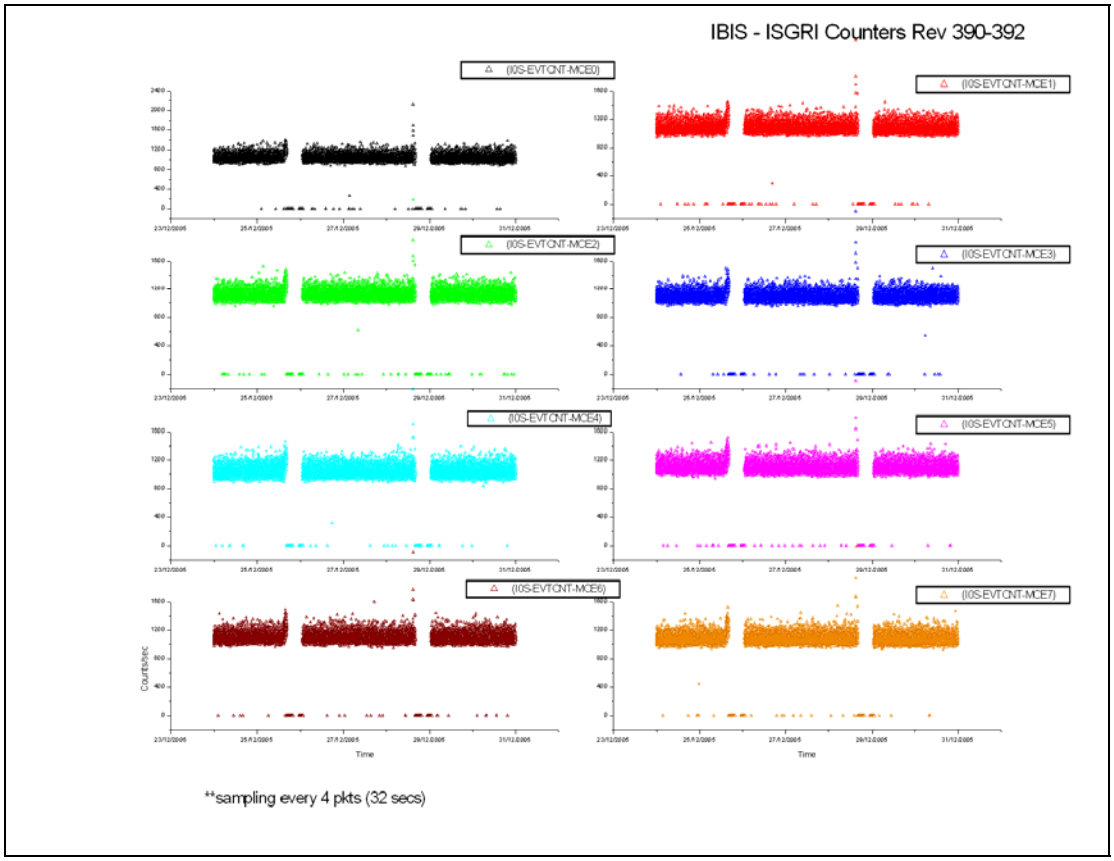
The following plots show the PSD channel rates during the reporting period



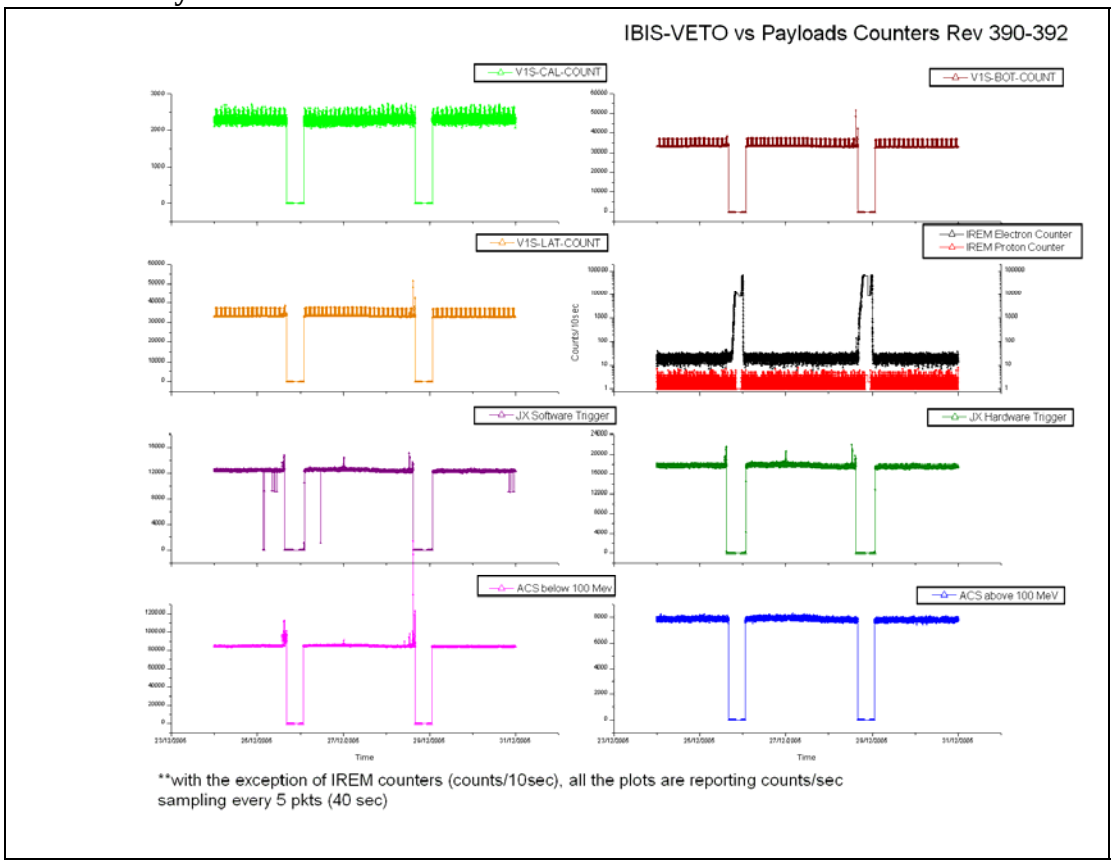
8.3.3 IBIS Operations

IBIS Event Counters Plots.

ISGRI Counters:

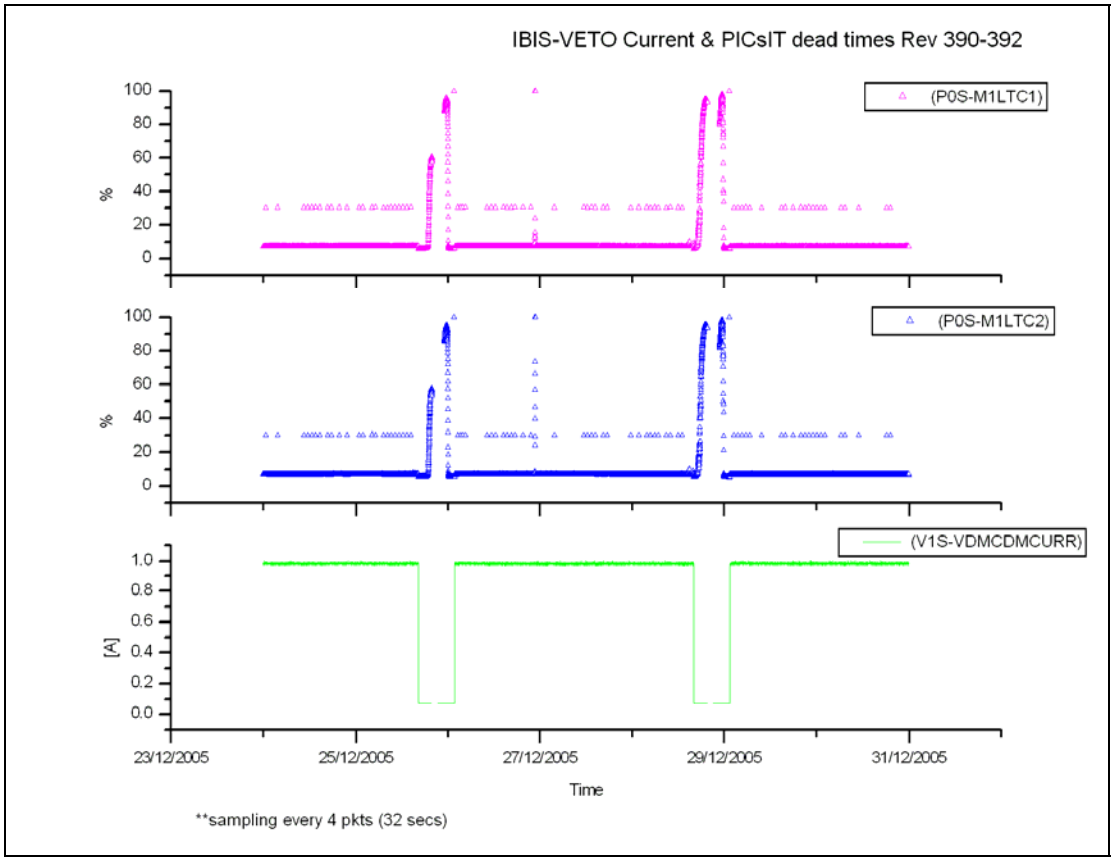


VETO vs Payloads Counters:

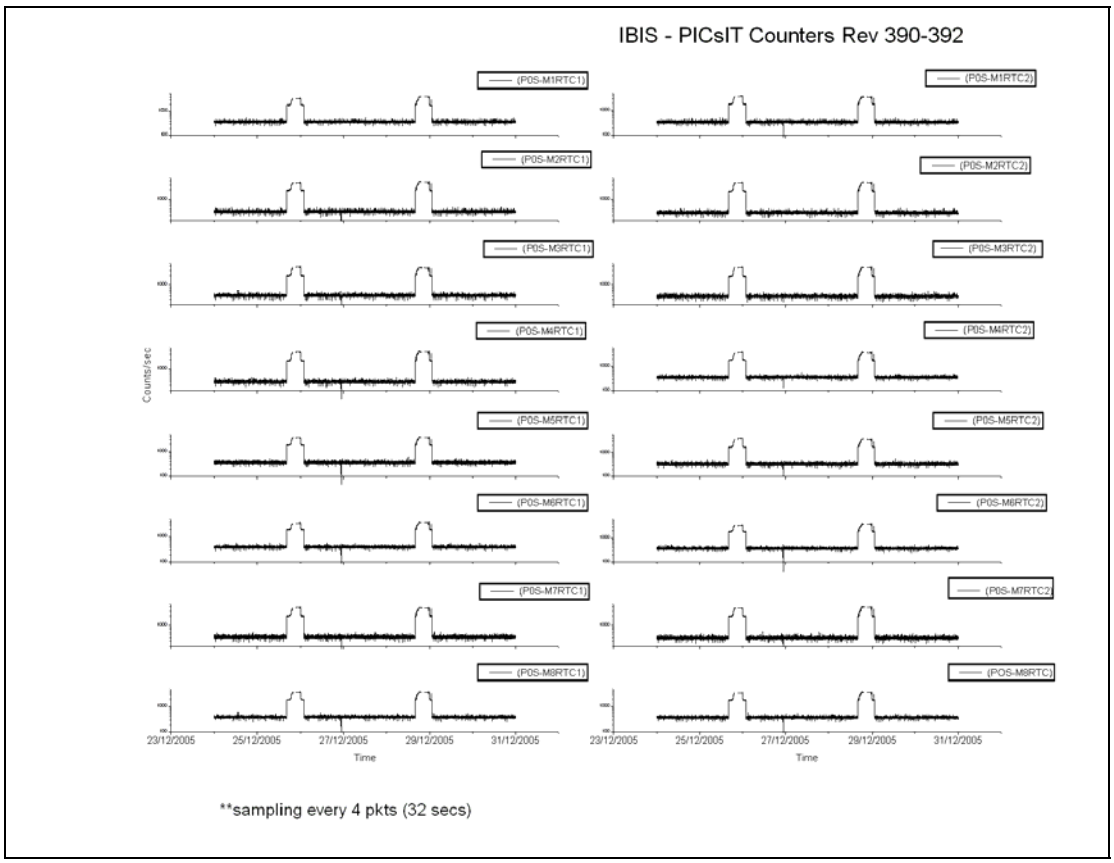


The week was characterised by low radiation.

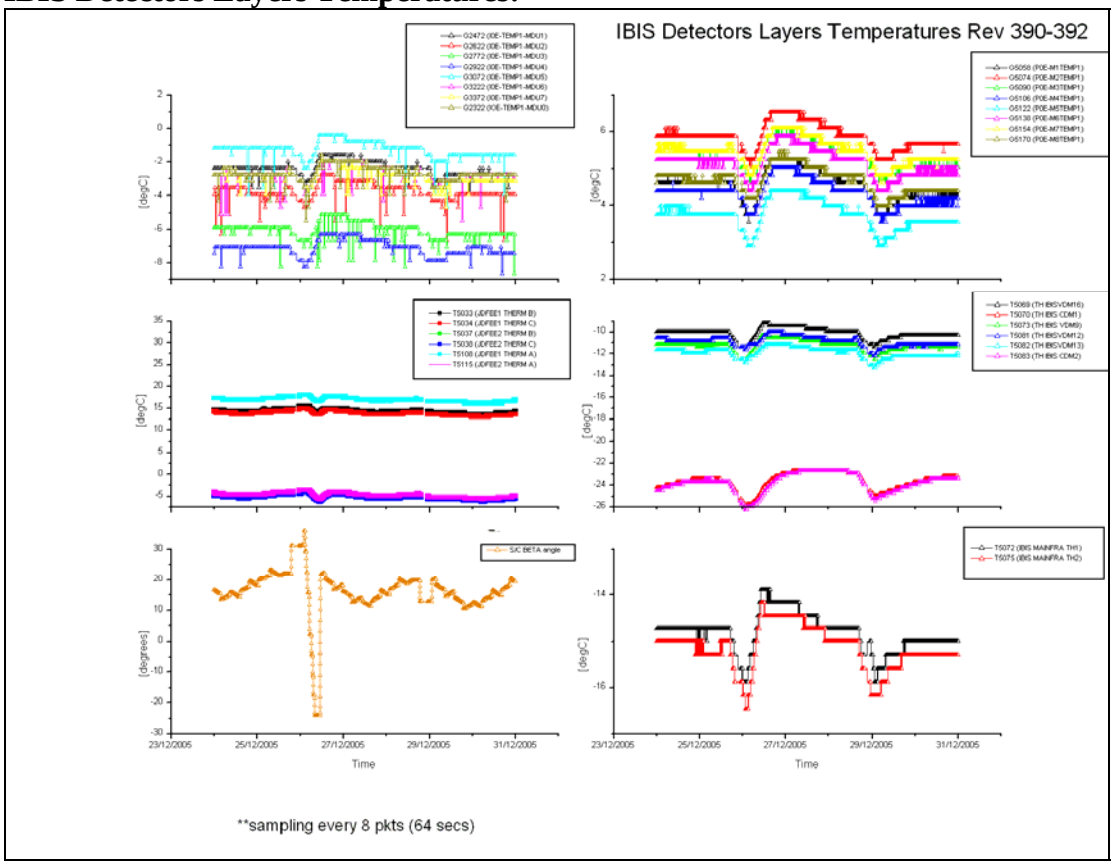
VETO Current:



PICsIT Counters:



IBIS Detectors Layers Temperatures:



IBIS daily report

DoY 2005.359 (25/12/2005)

At 03:24Z according to INT_OR_0232, the LOBT wrap-around was performed putting IBIS to Stand-by mode until 04:10Z when TC G0129 (IBIS to Standard mode) was manually sent.

At 16:17Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 360 at 01:48Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.
Inside radiation belts, TM parameters G5018 (P0S-M4RTC2) and G5023 (P0S-M5RTC2) were toggling OOL high. According to P-CNT-1, no action was taken.
TM parameters G2084 (I0E-OVFWPXADD-M6) and G2014 (I0E-OVFWPXADD-M1) failed SCC in the same period of time. According to I-OVF-1, no action was taken.

DoY 2005.360 (26/12/2005)

At 22:40Z, TM families G5068 and G5072 (P0S-MiF1ERRF and P0S-MiF2ERRF) failed SCC. At 22:45Z, TM families G5002 and G5003 (P0S-MiRTC1 and P0S-MiRTC2) went OOL low-low. And, at 22:48Z, the On-Event Message, class 0 and ID 132, “IBIS1 IASW HEPI RESYNCHRONISED” was reported.

The occurrence of these 3 anomalies together flags a resynchronisation of the HEPI and does not require any recovery as indicated in the FDIR.

DoY 2005.362 (28/12/2005)

At 14:57Z TM parameters G6062 (V1S-LAT-COUNT) and G6063 (V1S-BOT-COUNT) were reported OOL High and back. According to V-LAT-1 and V-BOT-1, no action was taken.

At 16:01Z TM parameter G8015 (S1E-A2_PMT_V) was reported Out Of Limit high. It went back inside limits on DoY 363 at 01:31Z. As this happened inside the radiation belts, according to V-VLT-1 no action was taken.
Inside radiation belts, TM parameters G5002 (P0S-M1RTC1) and G5028 (P0S-M6RTC2) were toggling OOL high. According to P-CNT-1, no action was taken.

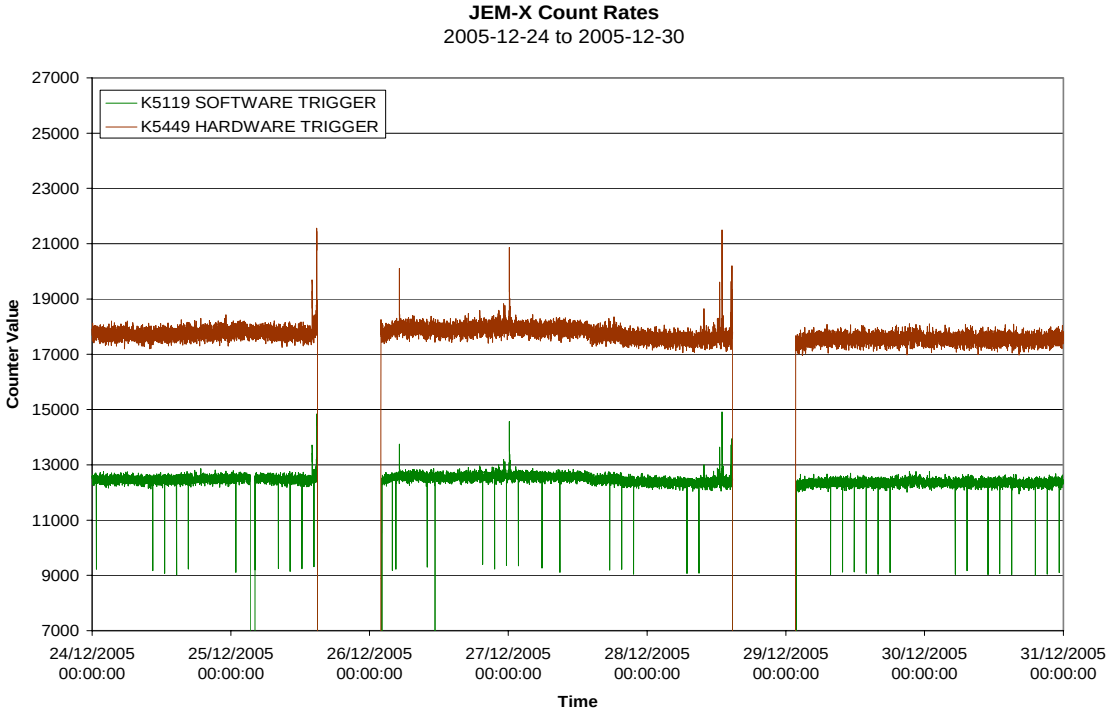
DoY 2005.364 (30/12/2005)

At 10:48Z TM parameter G2056 (I0E_OVFWPXADD_M4) failed SCC and back. This happened again at 23:20Z. According to I-OVF-1, no action was taken.

8.3.4 JEM-X Operations

8.3.4.1 JEM-X Count Rates

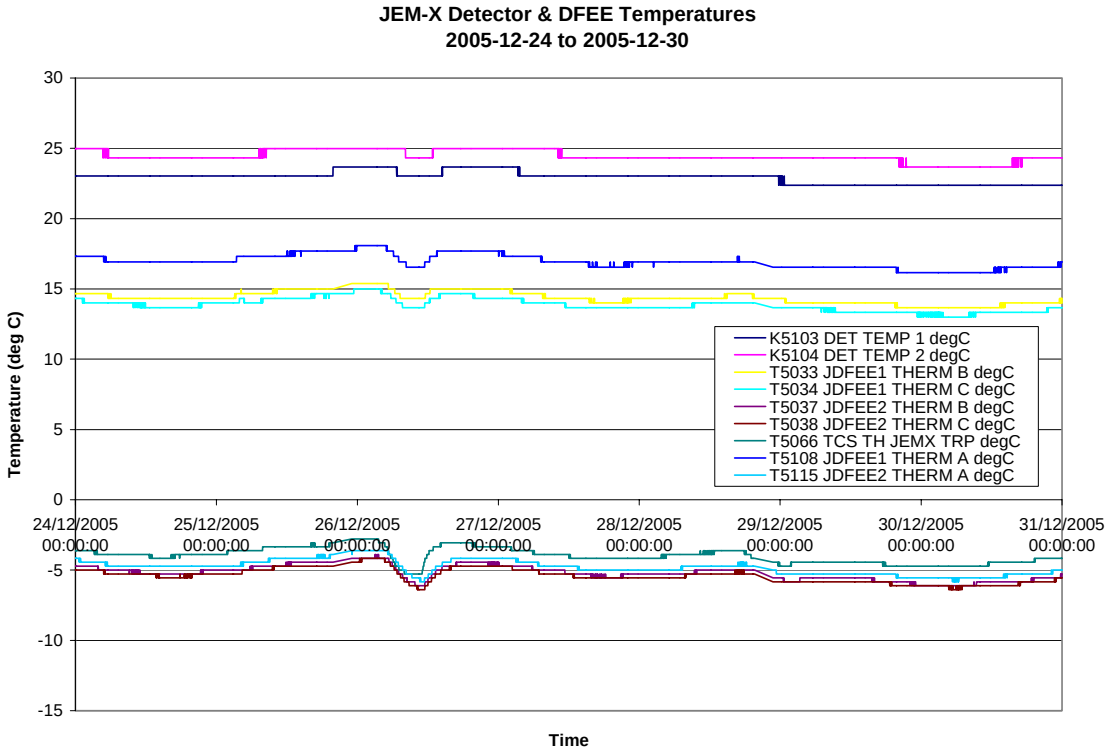
JEM-X count rates over the reporting period are displayed in the following graph[1].



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

8.3.4.2 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 graph[2].



8.3.4.3 JEM-X Daily Report

2005-12-24 (DOY 358, Rev 390)
Nothing to report

2005-12-25 (DOY 359, Rev 390-391)

At 03:22, according to INT_OR_0232, the LOBT wrap-around (which occurred at 03:42:17Z) was performed putting JEM-X1 manually to Set-up mode. It was recovered automatically by enabling CCCF in the Timeline at 03:43..

2005-12-26 (DOY 360, Rev 391) to 2005-12-30 (DOY 364, Rev 392)

Nothing to report

8.3.5 OMC Operations

2005-12-24 (DOY 358, Rev 390)

[2] Data sampled (1 frame in 8)

Nothing to report

2005-12-25 (DOY 359, Rev 390-391)

At 03:20:41, according to INT_OR_0232, the LOBT wrap-around (which occurred at 03:42:17Z) was performed putting OMC manually to Stand-by mode. It was recovered automatically by enabling CCCF in the Timeline at 03:43.

2005-12-26 (DOY 360, Rev 391)

At 04:32, an imcs task crashed, which caused the loss of pointings 03910005 and 03910006. It was at this time the following OMC commands were rejected:

```
2005.360.04.33.11.677   2005.360.04.33.17.951   1792   RealTime   131     TC REJECT
REJECTED TC1                                             0       0    65535   PR    N
E   E
2005.360.04.33.17.927   2005.360.04.33.26.074   1792   RealTime   131     TC REJECT
REJECTED TC1                                             0       0    65535   PR    N
E   E
```

These correspond to the M1130 (RESET IM) and MU1310 (IMAGING-A) commands for pointing 03910005.

At 04:32, an AOCS command failed release, which prevented the uplink of the commands for pointing 03910016, these were later manually uplinked after a delay of 20 minutes. It was at this time the following OMC commands were rejected:

```
2005.360.13.22.44.197   2005.360.13.22.54.400   1792   RealTime   131     TC REJECT
REJECTED TC1                                             0       0    65535   PR    N
E   E
2005.360.13.22.49.947   2005.360.13.22.54.424   1792   RealTime   131     TC REJECT
REJECTED TC1                                             0       0    65535   PR    N
E   E
```

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

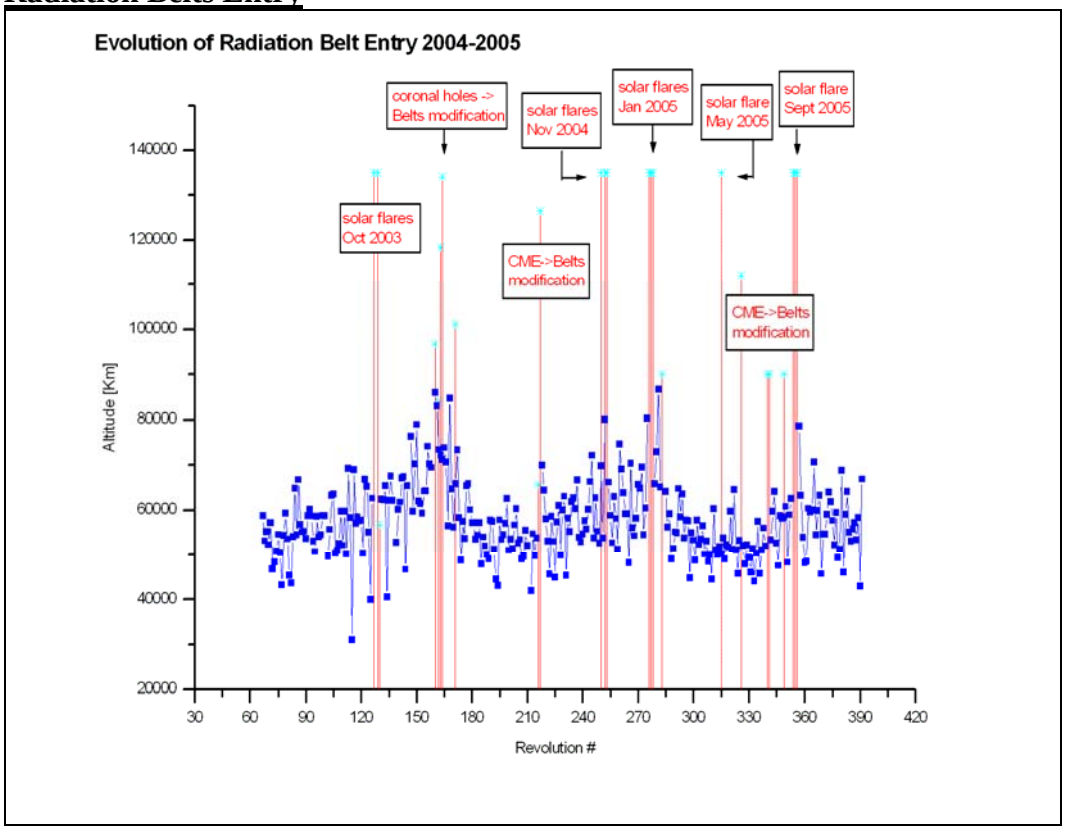
2005-12-27 (DOY 361, Rev 391) to 2005-12-30 (DOY 364, Rev 392)

Nothing to report

On DoY 359 at 16:17:49, DoY 362 at 16:01:25 OMC was switched by the Timeline to SAFE mode, at the nominal time.

8.3.6 IREM Operations

Radiation Belts Entry



IREM daily report

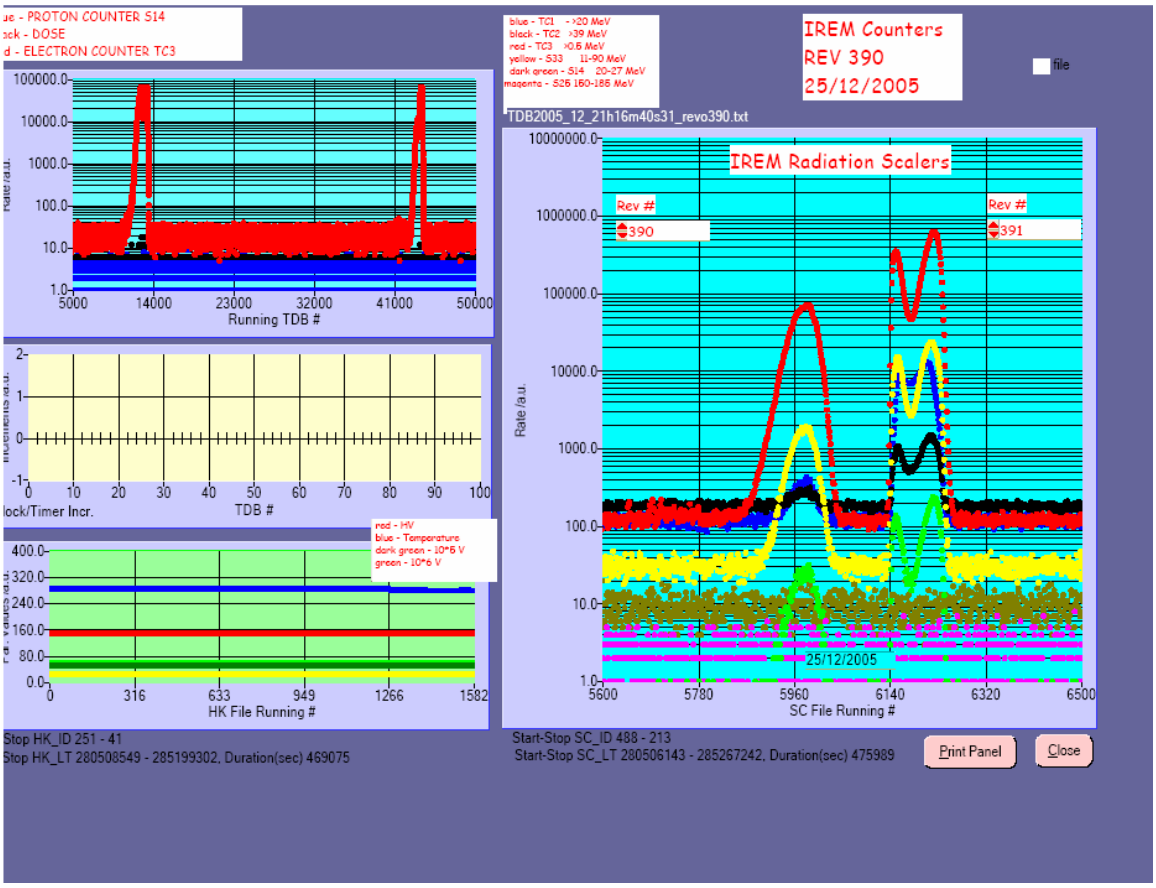
Nothing to report.

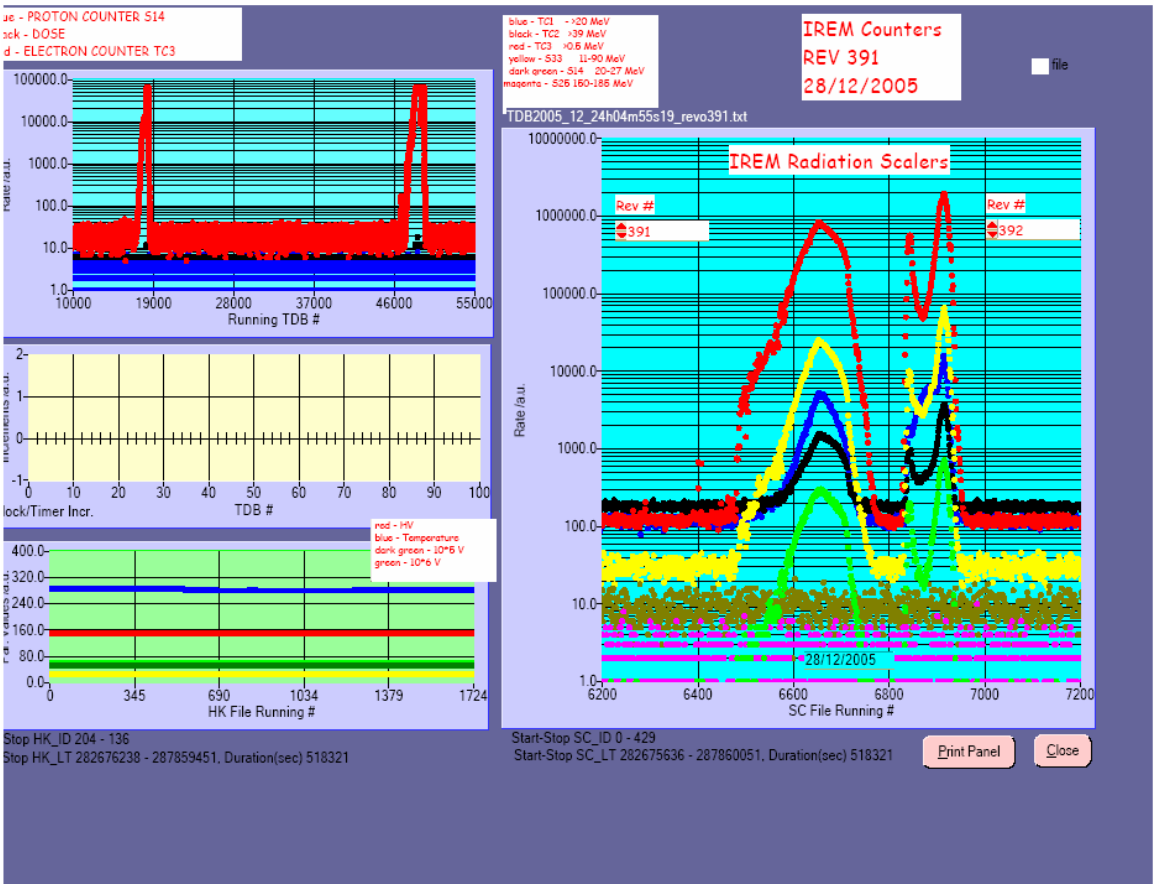
Electron Belts

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]
390	RAD_ENTR R 2005-12-25T16:17:47Z	2005-12-25 18:23:48	42941.0	2005-12-25 17:28:06	50705
391	RAD_EXIT R 2005-12-26T01:35:48Z	2005-12-26 00:30:52	>>23398.9	2005-12-26 00:48:06	32733
391	RAD_ENTR R 2005-12-28T16:01:21Z	2005-12-28 15:08:12	>66898.6	2005-12-28 17:12:47	50613
392	RAD_EXIT R 2005-12-29T01:19:06Z	2005-12-29 00:20:04	>>23392.8	2005-12-29 00:32:47	32883

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

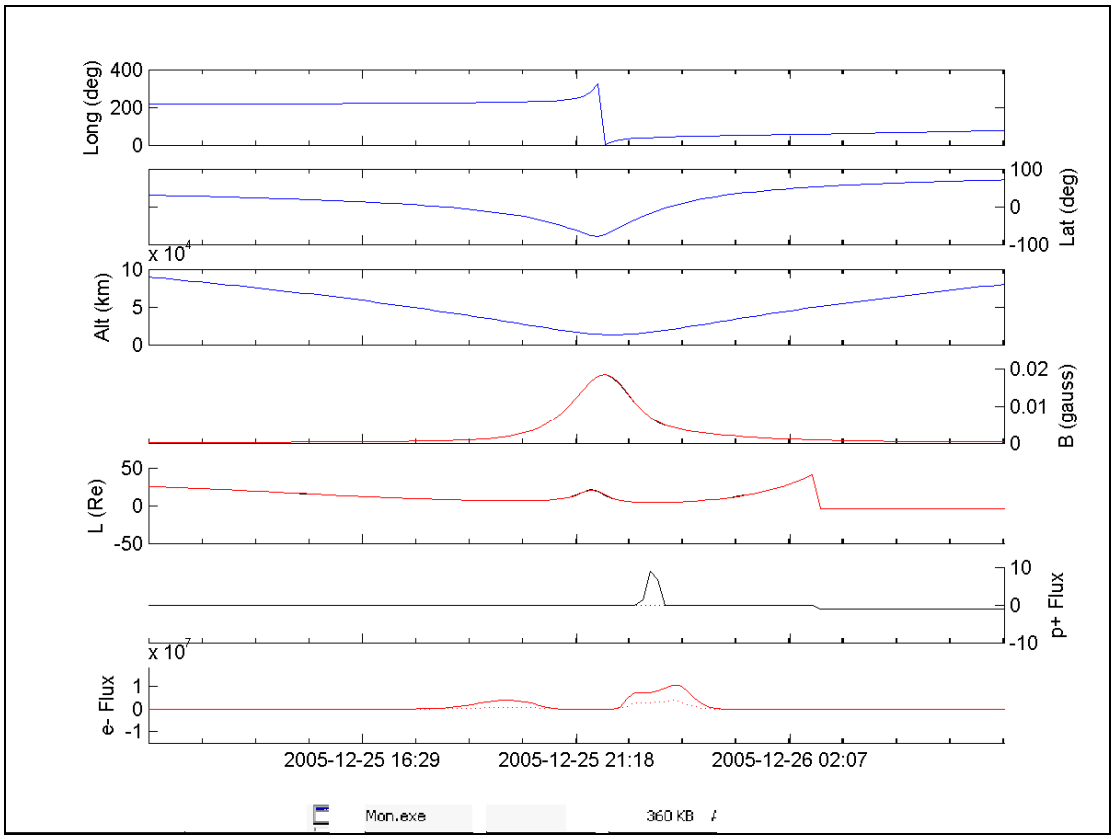
IREM radiation counters:



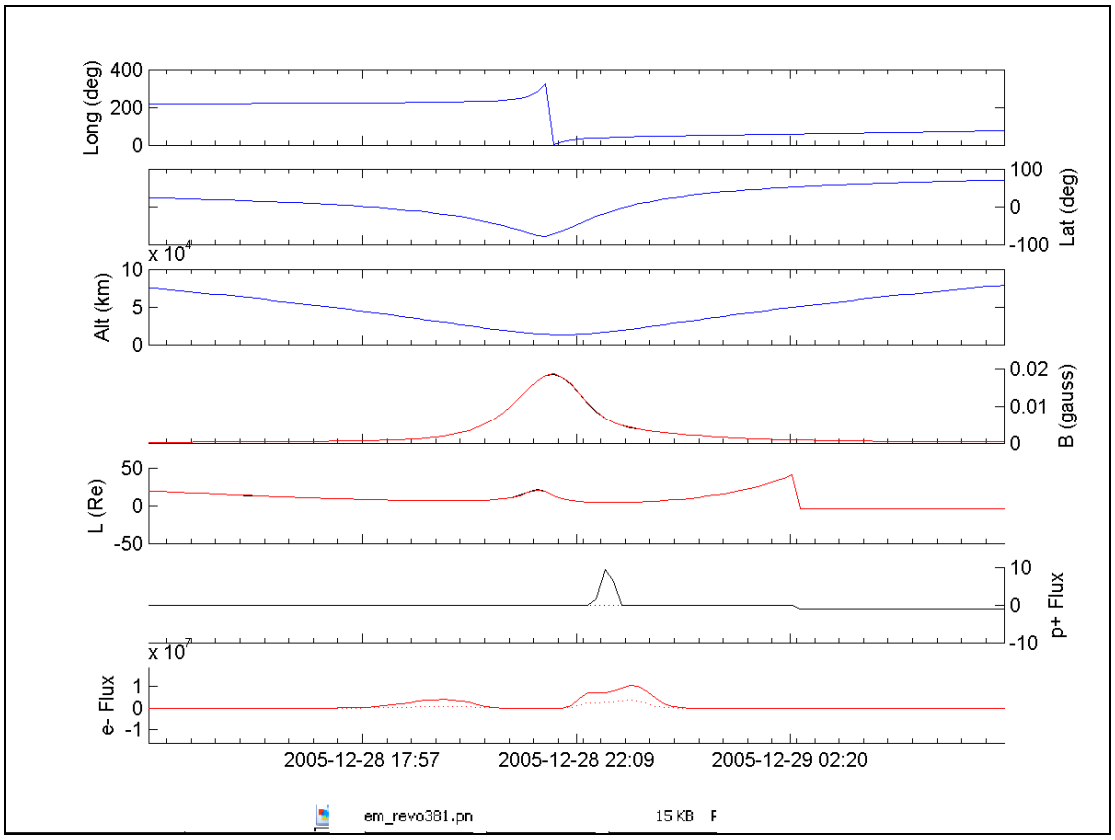


IREM Predicted Radiation Belt Passages:

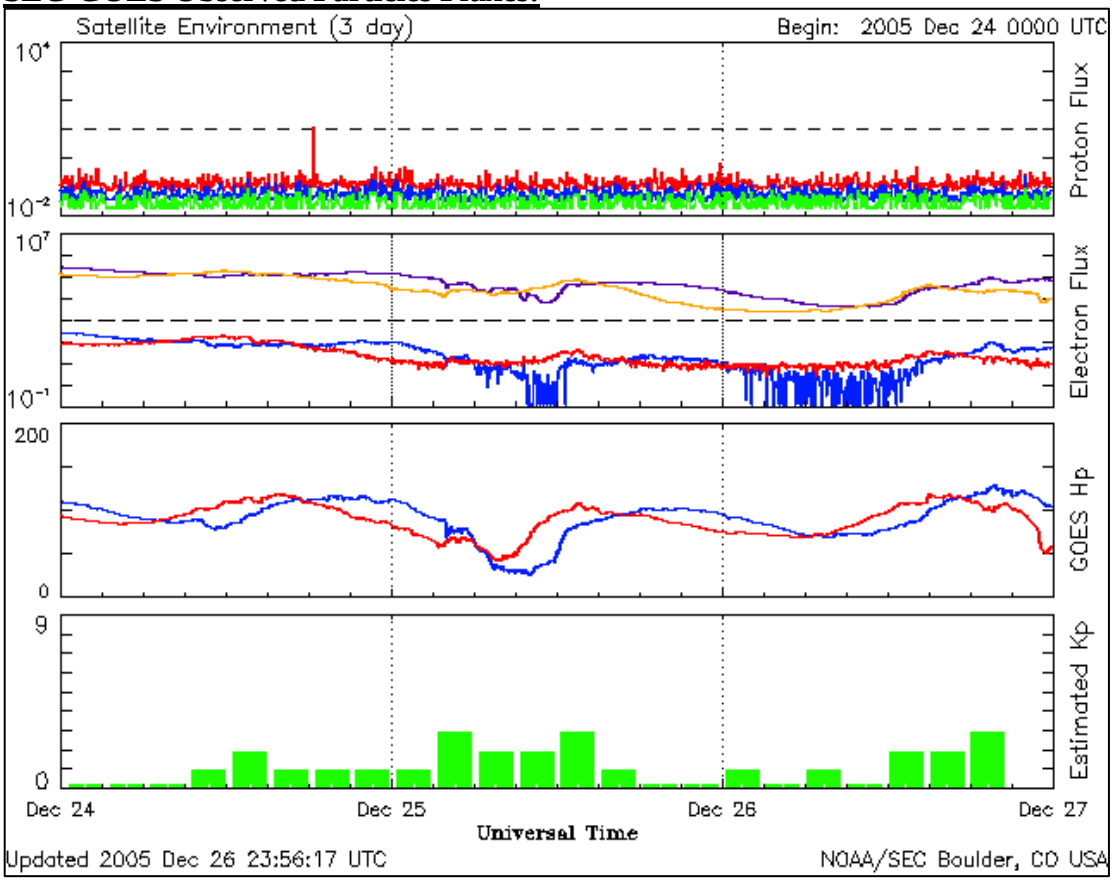
Rev 390

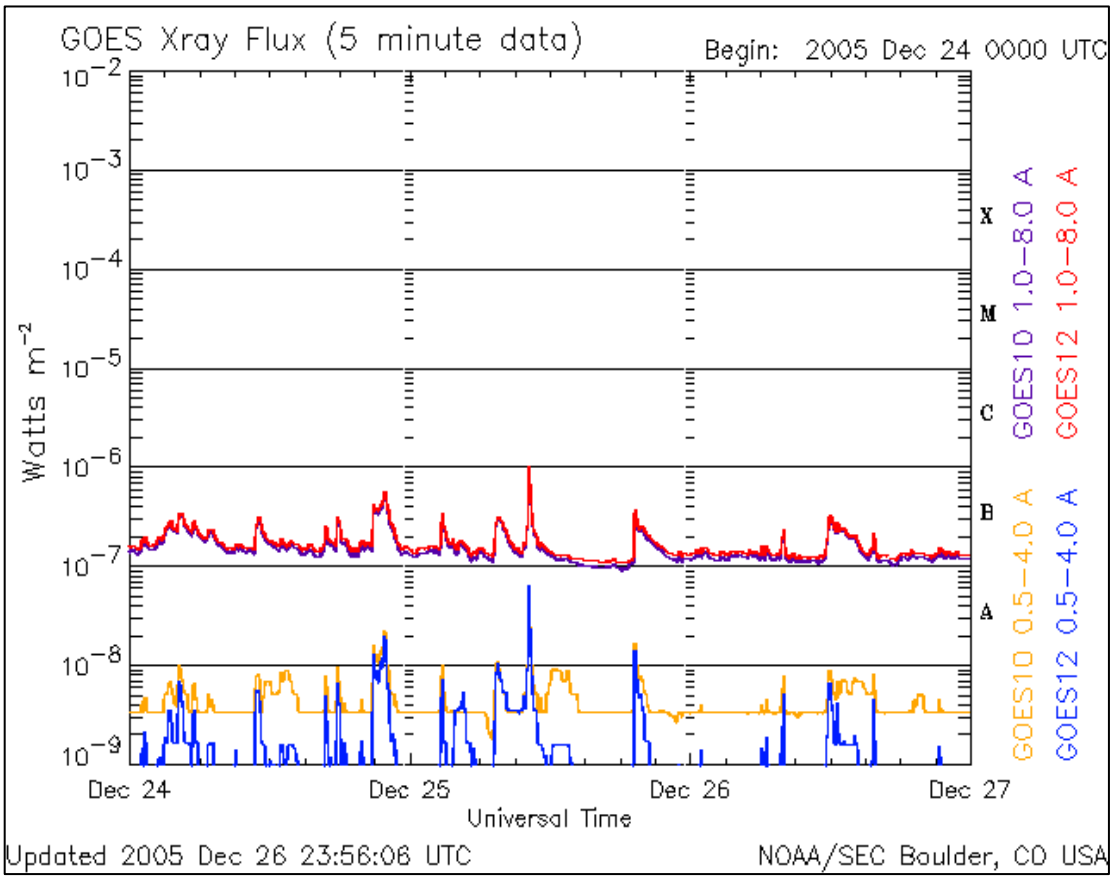


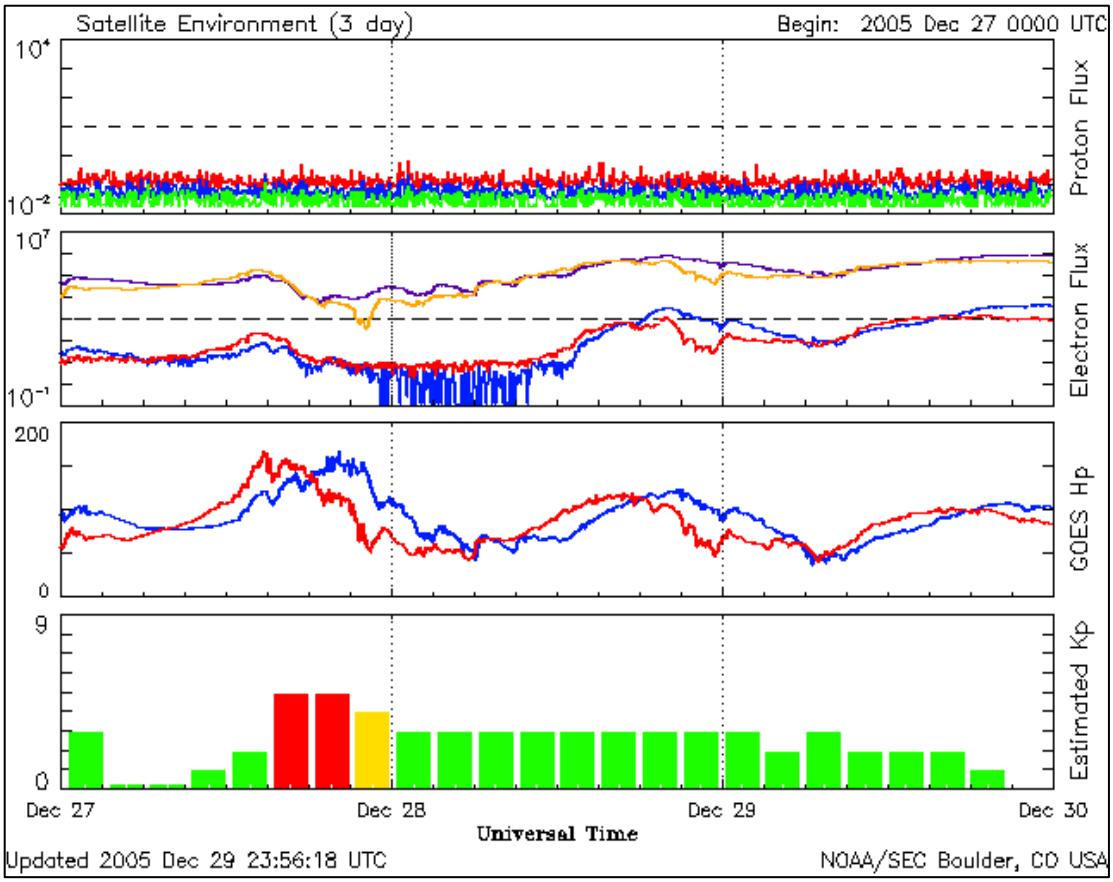
Rev 391

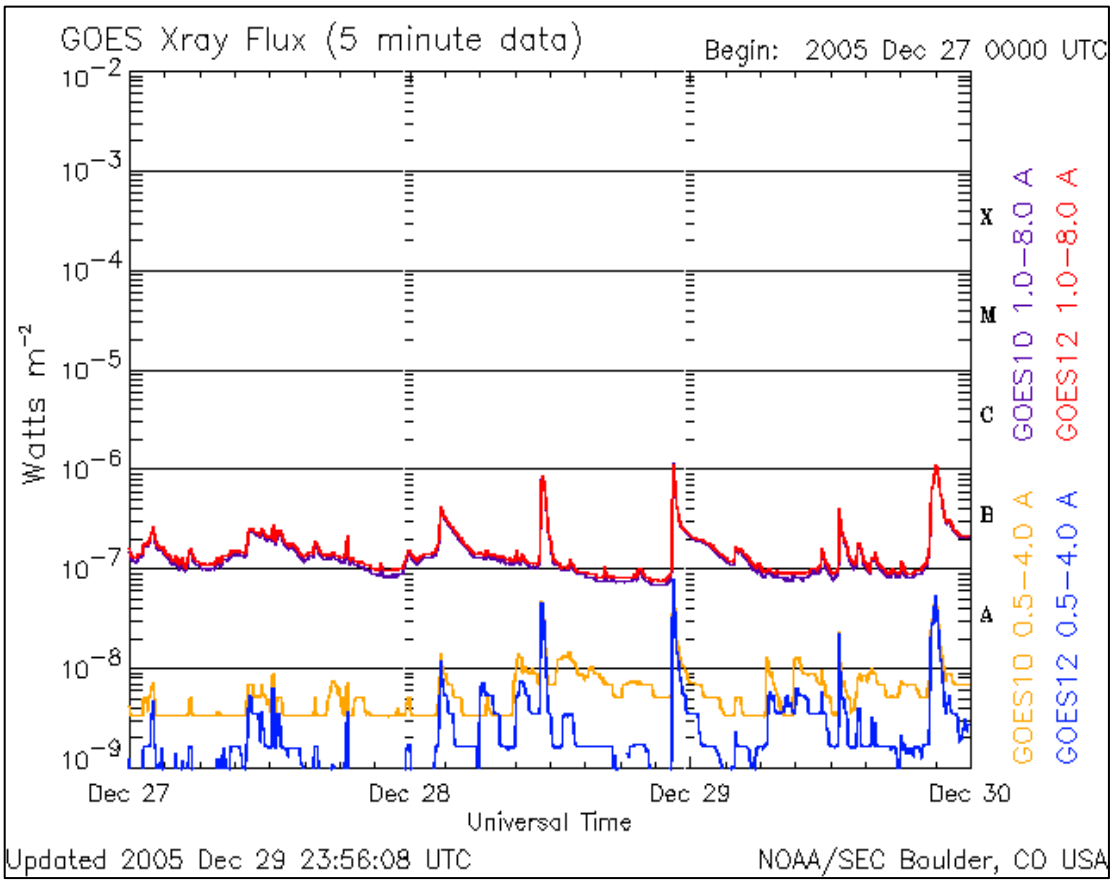


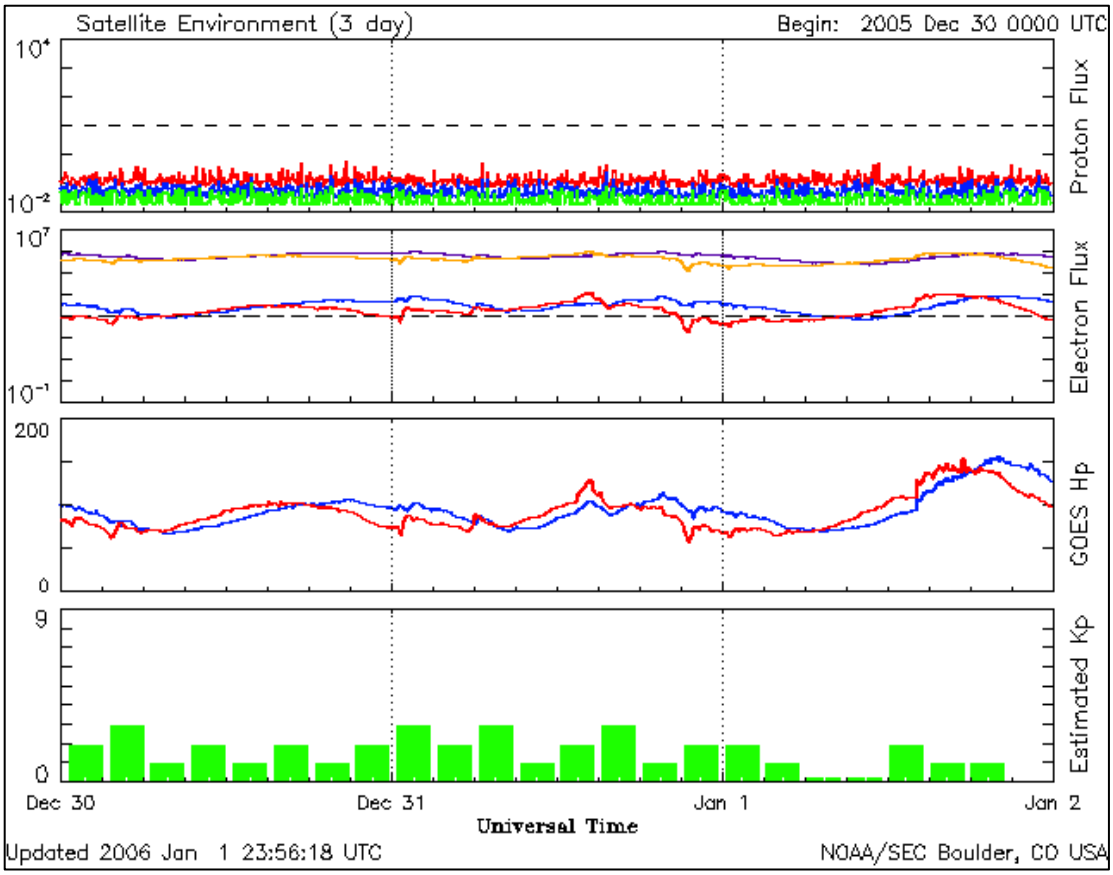
SEC-GOES Observed Particles Fluxes:

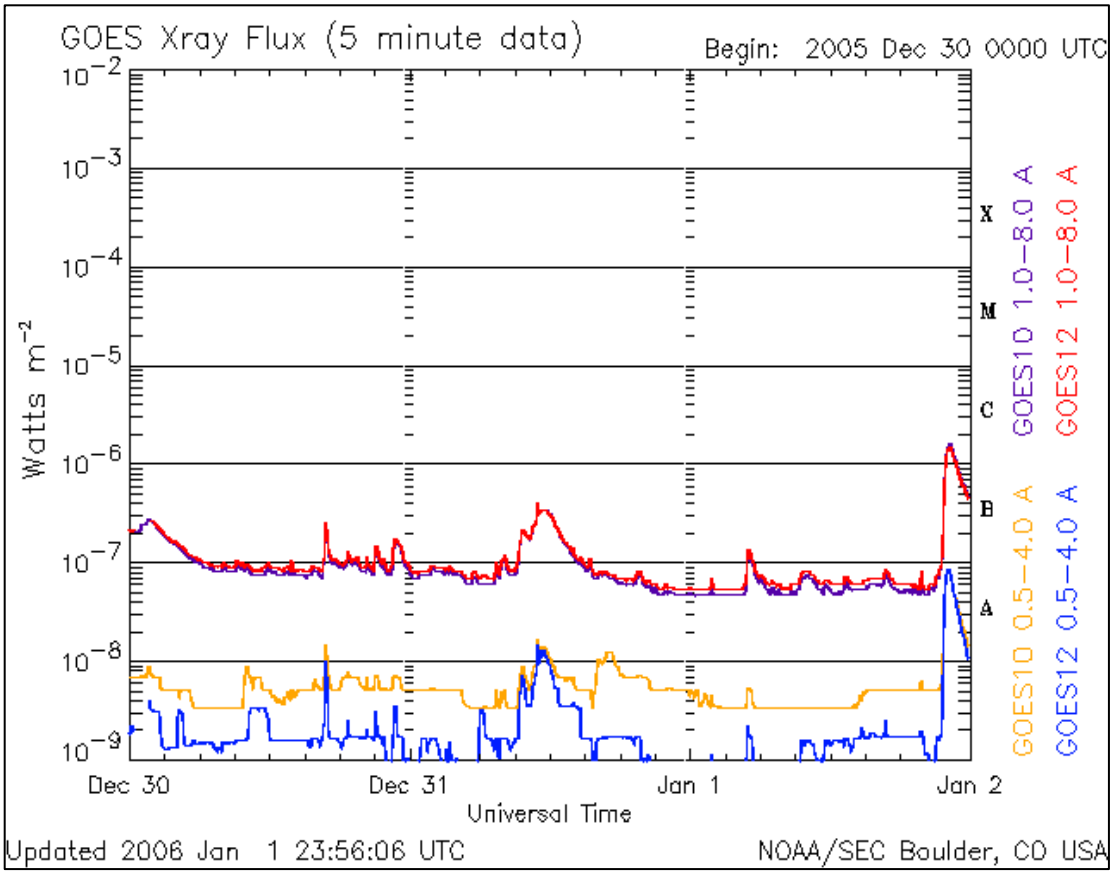





Satellite Environment (3 day)
Begin: 2005 Dec 27 0000 UTC
Proton Flux
Electron Flux
GOES Hp
Estimated Kp
Dec 27
Dec 28
Dec 29
Dec 30
Universal Time
Updated 2005 Dec 29 23:56:18 UTC
NOAA/SEC Boulder, CO USA


GOES Xray Flux (5 minute data)
Begin: 2005 Dec 27 0000 UTC
Watts m-2
X
M
C
B
A
GOES10 1.0-8.0 A
GOES12 1.0-8.0 A
GOES10 0.5-4.0 A
GOES12 0.5-4.0 A
Dec 27
Dec 28
Dec 29
Dec 30
Universal Time
Updated 2005 Dec 29 23:56:08 UTC
NOAA/SEC Boulder, CO USA


Satellite Environment (3 day)
Begin: 2005 Dec 30 0000 UTC
Proton Flux
Electron Flux
GOES Hp
Estimated Kp
Dec 30
Dec 31
Jan 1
Jan 2
Universal Time
Updated 2006 Jan 1 23:56:18 UTC
NOAA/SEC Boulder, CO USA


GOES Xray Flux (5 minute data)
Begin: 2005 Dec 30 0000 UTC
Watts m-2
X
M
C
B
A
GOES10 1.0-8.0 A
GOES12 1.0-8.0 A
GOES10 0.5-4.0 A
GOES12 0.5-4.0 A
Dec 30
Dec 31
Jan 1
Jan 2
Universal Time
Updated 2006 Jan 1 23:56:06 UTC
NOAA/SEC Boulder, CO USA