

INTEGRAL
Mission Report
INT-MOC-SYS-RP-1001-TOS-OF
No. 053
Week 39
29.09.03
Routine Phase

Prepared by: M. Walker (TOS-OFI)

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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 and ISOC.

It addresses the activities from 20.09.03 until 26.09.03 (both dates inclusive) and covers the revolutions 115 & 116.

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 consisted of a raster dither of SgrA* (RA 17:45:40.00; DEC -29:00:28.0), and a Galactic Centre Deep Exposure.

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. There was an unexpected loss of the Guide Star during a Closed Loop Slew. This requires further investigation.

3.1.1 AOCS

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

The main AOCS event of this week was the loss of the guide star, during a Closed Loop Slew that as a consequence was aborted. This was the first time in the mission.

In addition two slews were lost due to a ground segment problem.

The fuel consumption over the period between 18/09/2003 and 26/09/2003 was 0.152Kg. The remaining propellant is in the order of 174.75 Kg on the 26th of September.

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 **2250W**. This means that there is no noticeable degradation of the solar arrays since launch. The average power consumption during Sunlight is in the order of 930 W and the maximum is about 1100 W.

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 identified.

3.1.5 RF

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 cryo-cooler is working well, with the temperature maintained 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 is 134 pkts/8sec.

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

3.2.3 JEM-X

During the reporting period, JEM-X2 operations were executed from the Automatic Timeline and JEM-X1 was dormant. A solar flare on DoY 268 caused JEMX-2 to go to SAFE mode.

Note: Some more information concerning the JEM-X operations is provided in the Appendix

3.2.4 OMC

During this period 174 OMC images were acquired with 2 missed, due to a Reed-Solomon problem at Redu.

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

3.2.5 IREM

The status of the unit is Nominal.

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

4 Ground Facilities

The performance of the ground segment was within the specification. The operations were executed smoothly, the main problems this week, as previous weeks, concern the consolidator, and the link to the ISDC.

4.1 Mission Operations Centre

The performance of the MOC was OK. Apart from repeated problems concerning the Consolidator and the link to ISDC, there was a malfunction of the autostack (see also section 6).

4.2 Ground Stations & Network

The performance of the Ground Stations and the Operational Network was good in the reporting period. There were a few malfunctions (see section 6) that impacted the TM/TC links but had only small impacts on the mission execution.

4.3 Science Ground Segment

4.3.1 ISOC

Note:

This section includes a report from the ISOC team concerning the performance of ISOC. The ISOC reporting period is not in synch with the one of MOC and covers the period from the middle of week 38 until the middle of week 39.

1. Planning.

Short term PSF: up to rev. 123 received from MOC

Long term PSF: up to rev. 140

POS and POD generated: up to rev 123 and sent to MOC and ISDC

TSF: up to rev 117 received from MOC

Replanning of rev's 115 to 119 was performed due to problem with cycle 2 of GCDE and modified IBIS parameter setting. Rev. 117 was replanned a second time due to new PSF from MOC. Rev. 116 POS was edited by MOC manually instead of sending new PSF. Changes to rev 116 and 117 was changed Ground Station handover windows.

ISOC has also made long term plans covering up to AO 1, i.e. rev 146. In principle all remaining AO 1 observations to be scheduled has been agreed. If a SPI annealing is agreed it will be performed in rev's 129 to 135. Observations to be performed in parallel with the annealing have been found.

2. Observation status

ECS's up to rev 97 have been received from ISDC. Corresponding OCS's sent to ISDC .

3. ISOC science archive

One data partition received from ISDC covering up to rev 33. A first version of the archive browser developed by the Archive group in VILSPA has been installed and is under evaluation. This browser is based on the same technology as the ISO and XMM Newton browsers.

4. System

The system performance is very stable

5. Problems

Some grids for the cycle 2 of the GCDE survey should have been slightly offset with respect to cycle 1. The software was updated and installed on the operational system.

4.3.2 ISDC

There were repeated problems concerning the link to the ISDC reported many times every day during this week. It should be emphasised that 'lost' data is recovered when the CD's produced by the MOC are delivered to ISDC. One possible explanation is that the ESOC network is sometimes under external attack, which can impact the performance of the Firewall. However, further investigations concerning these interruptions are required.

5 Special Events

Nothing to report

6 Anomalies

The only anomaly related to the space segment was the loss of the Guide Star during a Closed Loop Slew. The problems concerning the Ground Segment were mainly related to the data consolidation and the link to ISDC.

As far as the MOC is concerned there was a malfunction of the autostack on doy 264 at 23:02. Commands were released though the release time were in the future. There was no operational impact because the Pre-Transmission Verification (PTV) check stopped the Timeline.

During this week, the following events relating to the ground stations were reported:

- On DoY 264 at 06:05, VC7 TM from DSS-16 dropped, it was not recovered until 06:46, when the handover to Redu was completed. The corresponding discrepancy report number is N101419.
- On DoY 264, between 23:35 and 23:38, double VC7 TLM was being received from DSS-24, OSC removed one channel, and the rate returned to normal. The corresponding Discrepancy Report number is G-10332.
- On DoY 266, at 23:41, there were Reed-Solomon alarms at Redu, followed by 12 bad frames, there was no impact
- On DoY 267, at 07:36 there were more Reed Solomon alarms at Redu, which caused a drop in TLM. This in turn stopped the Timeline, which was not recovered until 08:43. The impact was slews 01150047 and 01150048 were lost. At 10:43 on the same day, there were more Reed-Solomon errors, also from Redu, this time without impact.
- On DoY 269 at 07:21, network reported they had 'lost' Redu, at 07:22, TLM returned, at 07:25, the TC was back, no impact. At 07:45 the TMPs were swapped (from TMP1 to TMP2), TMP1 was then restarted, at 08:00 and 10:17 there were more Reed-Solomon errors on both TMP1 and 2.

The list of the pending anomalies since Launch is currently under review and revised. New anomalies raised during the past week are listed below:

ARid	Date Occurrence	Subject	Segment	Element	Status
INT - 002451	22/09/2003	Free swap space alarm on NCTRS-A	Ground	NCTRS	Pending
INT - 002455	22/09/2003	Telemetry loss from DSS-16 DR	Ground	NASA	Pending

		N101419		Sta.	
INT - 002457	22/09/2003	Loss of some tasks on FDS L servers	Ground	FDS	Pending
INT - 002458	22/09/2003	ASTACK misses TC and releases others earlier than planned.	Ground	IMCS	Pending
INT - 002460	22/09/2003	Telemetry loss via REDU due to servo failure	Ground	ESA Sta.	Pending
INT - 002463	22/09/2003	Double telemetry rate received from DSS-24 DR: G-10332	Ground	IMCS	Pending
INT - 002464	24/09/2003	Telemetry loss from REDU due to Reed Solomon Alarms	Ground	ESA Sta.	Pending
INT - 002465	24/09/2003	Telemetry Delivery to ISDC	Ground	IMCS	Pending

7 Future Milestones

Apart from the SPI Annealing that is now planned for early November a few patches regarding the Instrument Application S/W are in the pipeline. This concerns SPI, IBIS and OMC. The upload of these patches is planned during the annealing period of SPI.

8 Appendix

The appendix includes various detailed information.

8.1 Overview of Revolutions

Revolution 115

The observations in revolution 115 consisted of an amalgamated raster dithering observation of SgrA* and the Galactic Center (RA 17:45:40.00; DEC -29:00:28.0) lasting ~57 hours, followed by a GCDE observation which was performed for the remaining ~2.5 hours of observation time.

Revolution 116

In revolution 116 a series of GCDE observations were performed throughout the available observation time (~61 hours).

Throughout these observations all instruments were in their nominal science modes, except for JEM-X1, which remained in Safe mode, and the TM allocation was 134 IBIS, 98 SPI, 1 JEM-X1, 8 JEM-X2, 5 OMC.

8.2 Consumables

8.2.1 Detailed Fuel Book-keeping

Doc. Title : INTEGRAL Mission Report # 53
Doc. Ref. : INT-MOC-SYS-RP-1001-TOS-OF
Date : 29/09/03

Issue : 1
Rev. : 0
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2003-09-07T05:06:03.000Z	175.0524	F	Automatic TM processing.
2003-09-07T10:31:24.000Z	175.0503	F	Automatic TM processing.
2003-09-08T21:41:03.000Z	175.0165	F	Automatic TM processing.
2003-09-10T10:18:19.000Z	175.0086	F	Automatic TM processing.
2003-09-11T21:27:35.000Z	174.9931	F	Automatic TM processing.
2003-09-13T10:05:22.000Z	174.9826	F	Automatic TM processing.
2003-09-14T21:14:46.000Z	174.9562	F	Automatic TM processing.
2003-09-16T09:54:10.000Z	174.9324	F	Automatic TM processing.
2003-09-17T21:04:37.000Z	174.9049	F	Automatic TM processing.
2003-09-19T09:48:09.000Z	174.8878	F	Automatic TM processing.
2003-09-20T20:59:41.000Z	174.8198	F	Automatic TM processing.
2003-09-22T09:35:13.000Z	174.8150	F	Automatic TM processing.
2003-09-23T20:44:37.000Z	174.7867	F	Automatic TM processing.
2003-09-25T09:23:37.000Z	174.7532	F	Automatic TM processing.

This report was generated Fri Sep 26 08:00:15 GMT 2003

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, 78 Open Loop Slews, 118 Closed Loop Slews and 5 Momentum Bias were executed. 2 slews were missed or executed manually, and one was aborted autonomously due to a loss of guide star. This is equivalent to a 1.5%.

20/09/03 (Day of Year 263, Revolution 114)

Slew executed with default parameters due to a FDS problem: The update of the parameters for slew 01140026 from the FDS failed. The slew was executed with default parameters. This had no impact since the slew was a close loop slew, and the guide star was properly acquired.

The reason for the problem was that a series of tasks were not running on the FDS. Apparently this was caused by a reboot of the FDS hardware platform in preparation for the SMART-1 launch. It is under investigation whether there is the need of a procedure change when FD performs this type of activities.

21/09/03 (Day of Year 264, Revolution 114)

ACC OTF flicker due to undetected False Event: For the pointing 0114046, the ACC selected a very dim guide star. The star (Tycho#6838-00776-1) has a catalogue expected instrumental magnitude of 8.59, and was detected by the STR with 8.5. This marginal star was affected by an undetected false event, causing a pointing error

above the OTF threshold both on Pitch and Yaw for one cycle at 09:17:58.188. This was not seen at Broadcast Packet level, and the problem had no impact.

ACC OTF flicker due to undetected False Event: The same problem happened during pointing 0114046. In this the ACC selected also a very dim guide star, with reported magnitude 8.5. The star does not appear in the normal catalogue extract used in the attitude log file. It has been flagged to FD for investigation. The jitter occurred twice, at 11:14:36.582 and 11:18:37.589. In both cases the problem was not seen at Broadcast Packet level.

22/09/03 (Day of Year 265, Revolution 114-115)

Nothing to report.

23/09/03 (Day of Year 266, Revolution 115)

Nothing to report.

24/09/03 (Day of Year 267, Revolution 115)

Slews missed due to TM drop (bad frames from Redu): At 07:38 there was an interruption in the TM, due to Reed Solomon failures in the frames (bad frames). The impact was that slew 01150047 was lost, and slew 01150048 was performed manually.

25/09/03 (Day of Year 268, Revolution 115-116)

Closed Slew aborted by guide star loss: During the execution of the closed loop slew 01160010, the guide star was lost leading to the abortion of the slew. It is the first time that this occurs during the mission. The behaviour onboard was as expected. This case is described in the Integral User Manual section 5.2.3.2.4.2.2. The sequence of events was:

14:47:42.686 Close loop starts.

14:48:31.178 False Event on the guide star, for 4 cycles. This occurred during the coast phase of the slew. Note that the star coordinates are frozen during the false event condition, while the star actually keeps moving. In this case the error in the frozen coordinates with respect to the probable real position of the star, was in the order of 4 arcminutes. The false event happened when the star data were: mag. 7.45, coordinates (-5383, 8622)

14:48:33.186 The false event disappears, and the star is lost. This is normal taking into account the description above (i.e. the star was not anymore at the position the STR was looking for it). The slew was aborted by the ACC, the controller was set in open loop (DCA 6, all errors set to zero), and the wheels commanded to reduce the rate to zero. In addition the ACC commanded a STR mapping, which eventually found the same guide star as before.

14:49:33.690 After one minute of open loop rate dumping (this is a fixed time in the ACC software), the controller switched to normal pointing mode (DCA=1, RGA=5), without SSL. At this point the guide coordinates were (-10440, 3570). Taken into

account that the target coordinates were (-26902, 395), it means that the attitude was 1.14° away from the nominal one for this pointing.

Unfortunately this problem caused a side effect in the update of the parameters for the next slew. When looking for the mapping after the close loop slew, the FDS starts with some margin before the nominal time. The software is not prepared to detect the peculiar conditions that happened this time, and it took erroneously the mapping that started at 14:48:33, when the guide was lost and the S/C was still moving. The result was that the attitude reconstructed was not the final one, and the parameters for the next slew were wrong, by around 15.5 arcminutes in the Y-Z plane, and around 4.3 arcminutes in alpha. This caused the roll error to exceed the OTF threshold immediately after the end of the slew. This was not seen by the Broadcast Packet.

In summary, the impact of this problem was:

Pointing 01160010 had the wrong attitude by 1.14°, and in addition the OTF remained low during this pointing. The attitude reconstruction for this pointing was some 15.5 arcminutes wrong.

Pointing 01160011 was affected at the beginning by a roll jump above the OTF threshold. In addition the attitude was around 15.5 arcminutes off with respect to the planned one.

It has also been seen that either the FDS not the ODB are properly prepared for this particular problem. There was no OOL issued, since there is no anomalous On Event Message issued by the ACC in this case, and the IMU is in principle not switched on. Some investigation needs to be done to see if this can be improved, at least at ODB level.

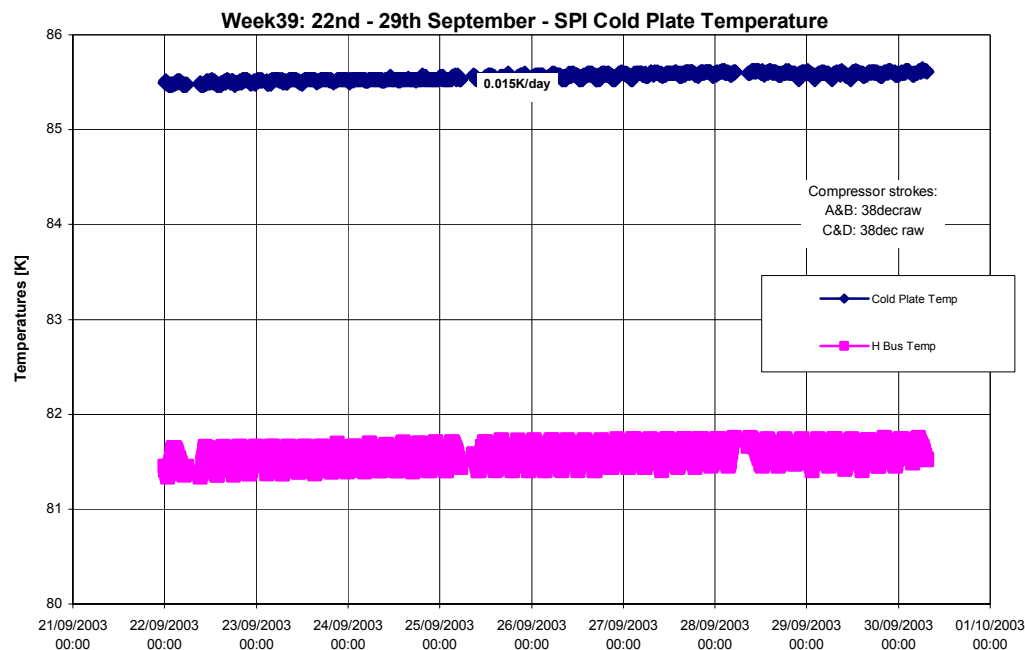
26/09/03 (Day of Year 269, Revolution 116)

Nothing to report.

8.3.2 SPI Operations

Cryo-cooler:

The long stabilization process, started after the annealing in July, is over: the temperature has leveled off at around 85.5K with a very small positive drift of 0.015K/day, well within the expected range.



IASW/DPE:

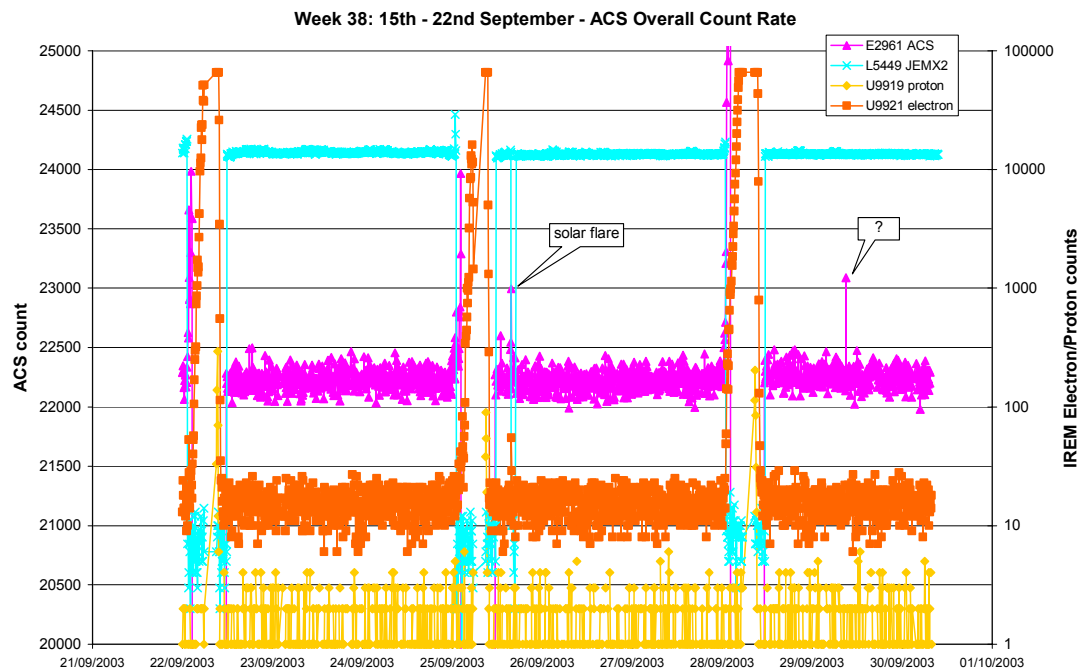
The OEM 242 “Failure in analyzing the HSL data” with parameters E9786=PSD, E9788=EOT, E9789=INVALID reported last week, has been clarified by SPI team, being an expected behaviour, already documented by the SPI User Manual.

ACS:

The figure below shows a plot of the ACS, IREM and JEMX2 count rate. Two unusual count rate peaks can be clearly seen in the ACS:

- on 25/09/2003 at 15:44z : the peak was explained by a solar flare, which was also detected by IREM electron counter and JEMX2 event trigger counter (JEMX2 turned itself off as a consequence of this flux peak);
- on 29/09/2003 at 09:00z : we could not find any explanation for it, neither the on board instruments have detected it nor any NOAA-GOES data is reporting unusual radiation peaks at that time.

SPI team has been contacted to help in the investigations.



AFEE :
 Nothing to report.

DFEE:

PSD:
 See IASW/DPE.

8.3.3 IBIS Operations

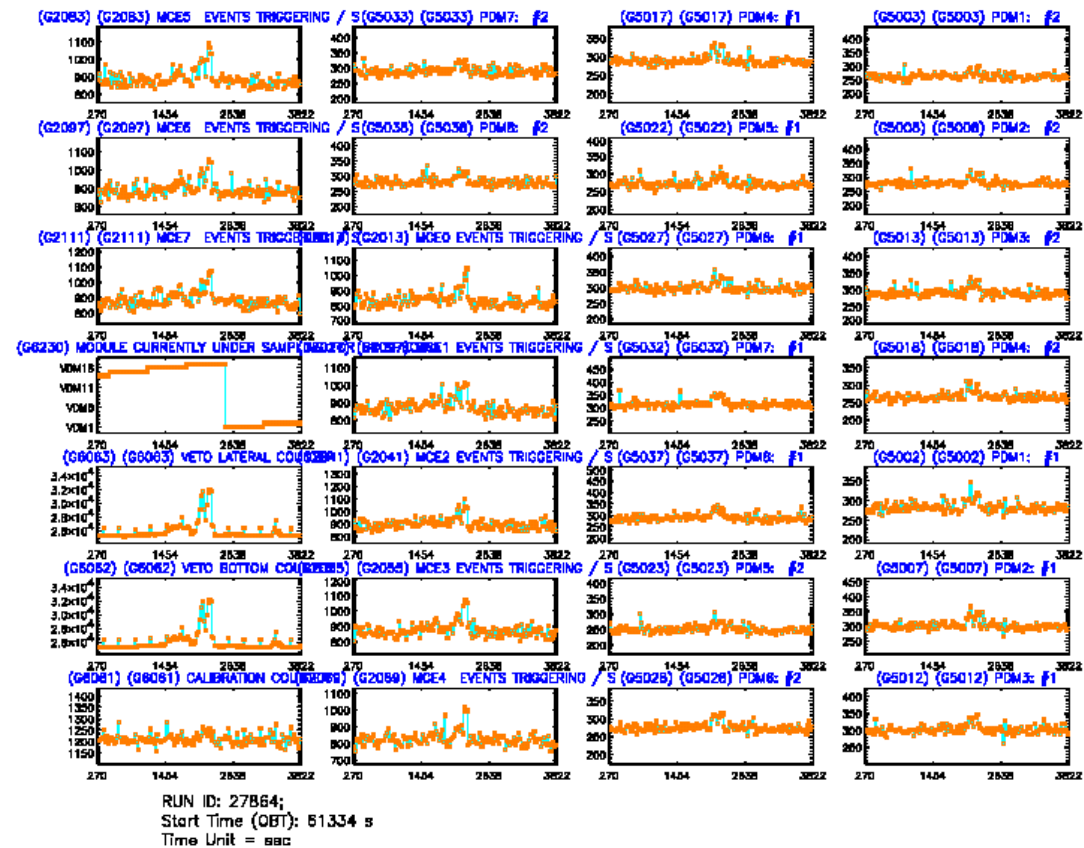
On DOY 2003.265 (22/09) there were a few reports during the Belt passage of the OEM APID 1280 ID 167 Class 2 <<IBIS1 PICsIT NOISY SEMIMODULE SIGNALLING>> due to the PICsIT detectors being ON without the VETO anticoincidence system, as it required by PIs. The Noisy semimodule was PDM5-SM1

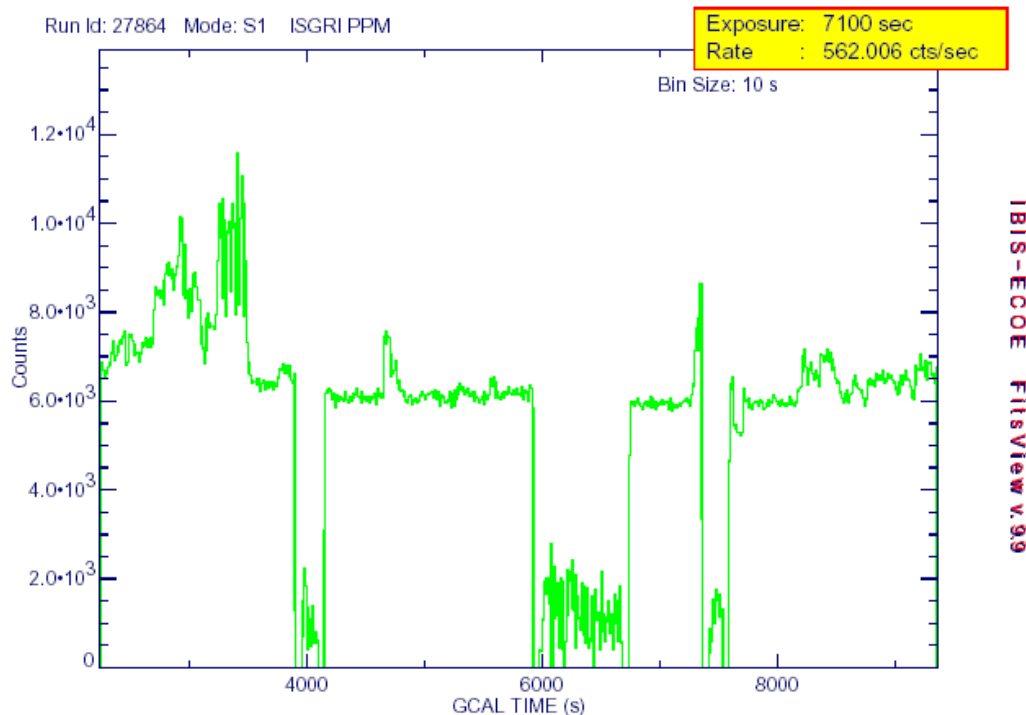
On DOY 2003.267 (24/09) at 23:19Z the OEM ID 180 Class 2 <<IBIS1 VETO COUNTER LATERAL EXCEEDS ALERT VALUE>> was reported. The relevant TM_para G6063 reported values inside limits after few TM cycles and therefore the problem has been disregarded, as suggested by the nominal reaction to this OEM.

On DOY 2003.268 (25/09) at 02:09Z the OEM ID 179 Class 2 <<IBIS1 VETO COUNTER BOTTOM EXCEEDS ALERT VALUE>> was reported. The relevant TM_para G6062 reported values inside limits therefore the problem has been disregarded, as suggested by the nominal reaction to this OEM.

Later, at 15:44Z a high radiation count-rate from the IREM electron conter (>3 counts/sec) was reported, possibly due to a solar-flare. The IBIS electron threshold was not exceeded (set to 20 counts/sec) and the event did not affect the IBIS configuration. The duration of the event , as registered by VETO, was ~900 secs.

The following plots show the detector count-rates during the event as registered by the IBIS PIs ECOE@MOC. The first plot shows the detector (VETO, ISGRI and PICsIT) count rates. The second shows the effect of the flare on the generation of S1 scientific data (ISGRI PPM).





On DOY 2003.269 (26/09) at 19:02Z the OEM ID 184 Class 2 <<IBIS1 VETO +28V VDM/CDM VOLTAGE OUT OF RANGE>> was reported. The relevant TM_para G6107 reported values inside limits and therefore the problem has been disregarded, as suggested by the nominal reaction to this OEM.

Acknowledgment to the IBIS team for use of the IBIS ECOE@MOC

8.3.4 JEM-X Operations

During the perigee passage of DoY 267, JEMX-2 autonomously switched to SAFE mode when L5119 (Software Trigger) exceeded limits, but on the passage of DoY 268, the entry to SAFE mode was commanded directly from the Autostack.

On DoY 268 at 15:44, JEM-X2 went into SAFE mode. This was initiated when L5119 exceeded limits, and occurred after exit from the radiation belts. The cause was a solar flare, at 17:17, JEMX-2 was reconfigured in DATA_TAKING mode. See IREM report.

8.3.5 OMC Operations

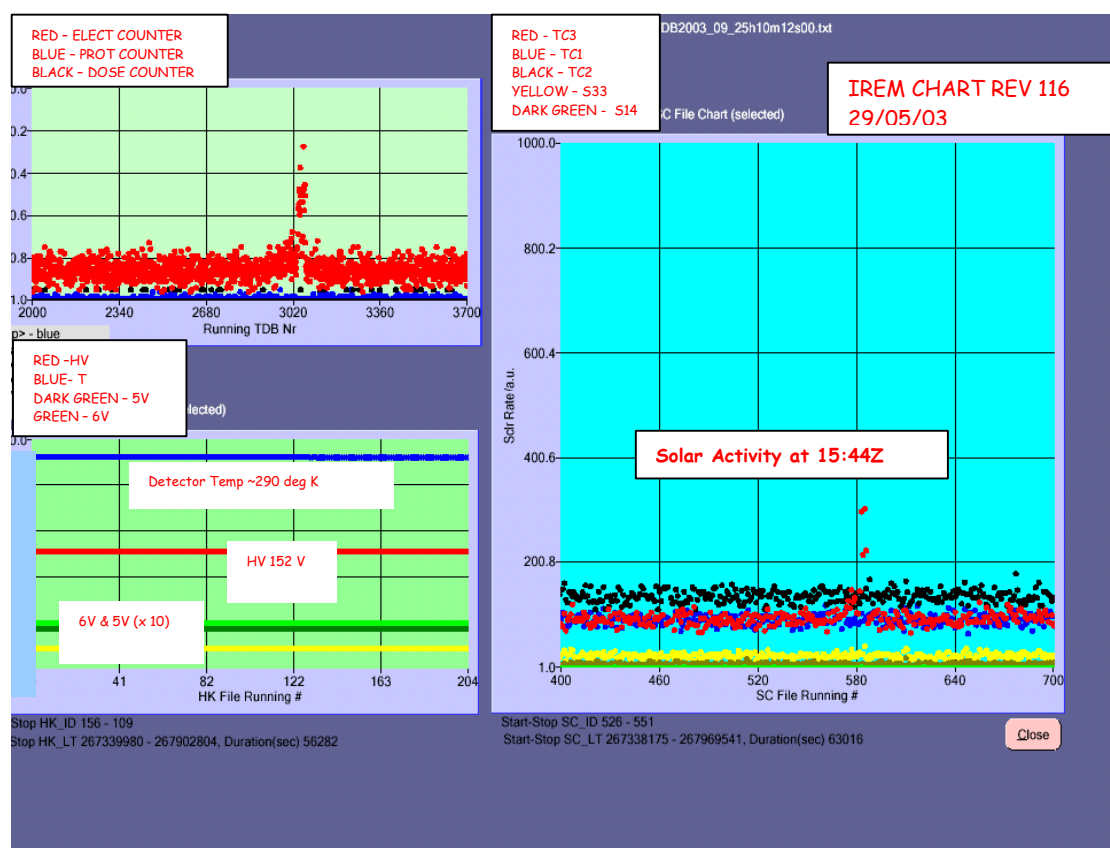
On DoY 267 at 07:41, 2 telecommands were rejected, this was caused when pointing 01150047 was lost, another pointing was lost before the Timeline was recovered at 08:43.

On DoY 268, from 15:24 to 15:51, there were 18 SCI WINDOW REJECTED messages received. This was caused by the failure of the closed-loop-slew 01160010 and the subsequent effects. See section 8.3.1 AOCS Operations for further details

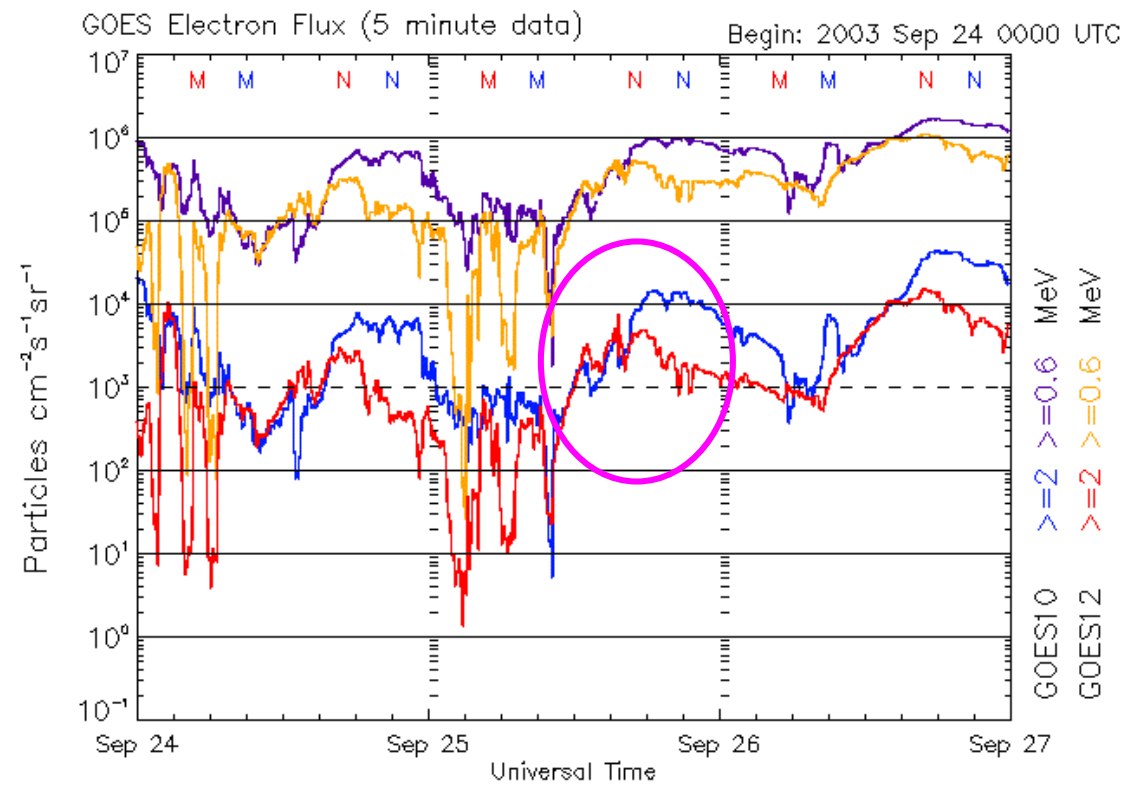
8.3.6 IREM Operations

On DOY 2003.268 (25/09) at 15.44 a possible solar event was reported. This event (flare) exceeded the electron threshold for JEM-X2 (> 6 counts/sec) causing the following transition to Safe Mode of the unit.

Below, the event as seen from the IREM counters (TC3, sensitive to electrons > 0.5 MeV) is shown:

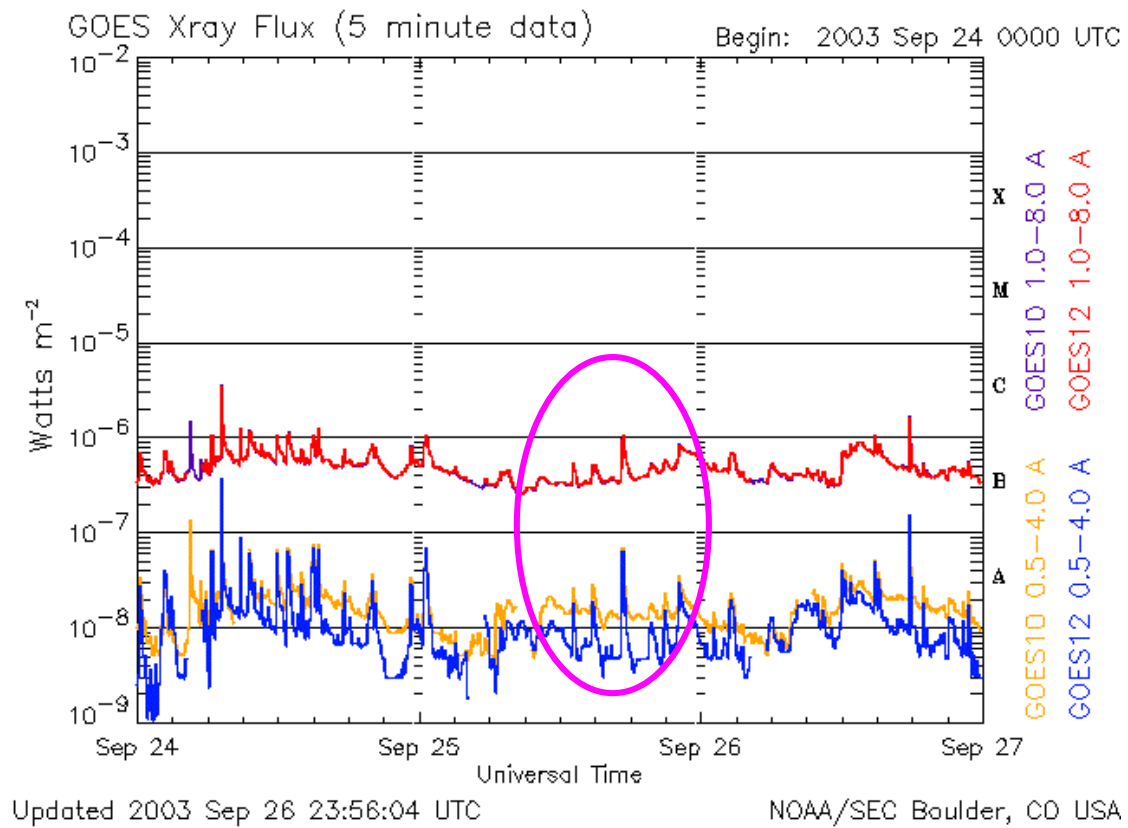


and as registered by the GOES satellites either for the electron either for the X-ray Flux.

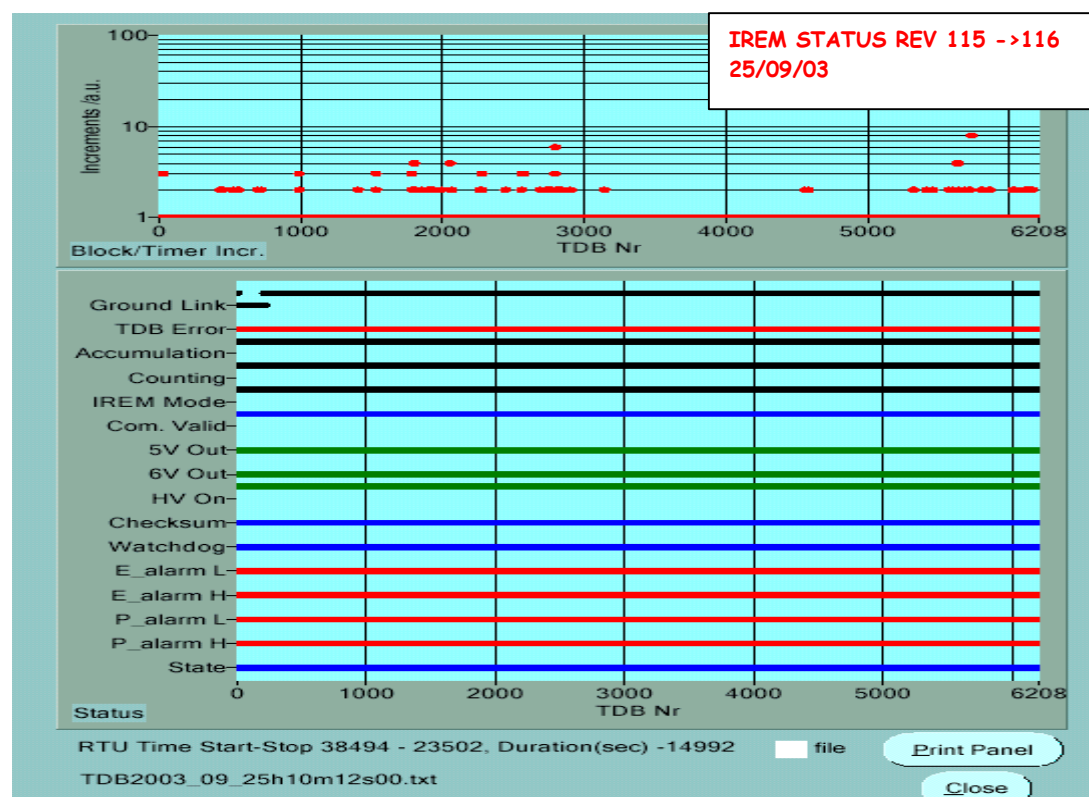
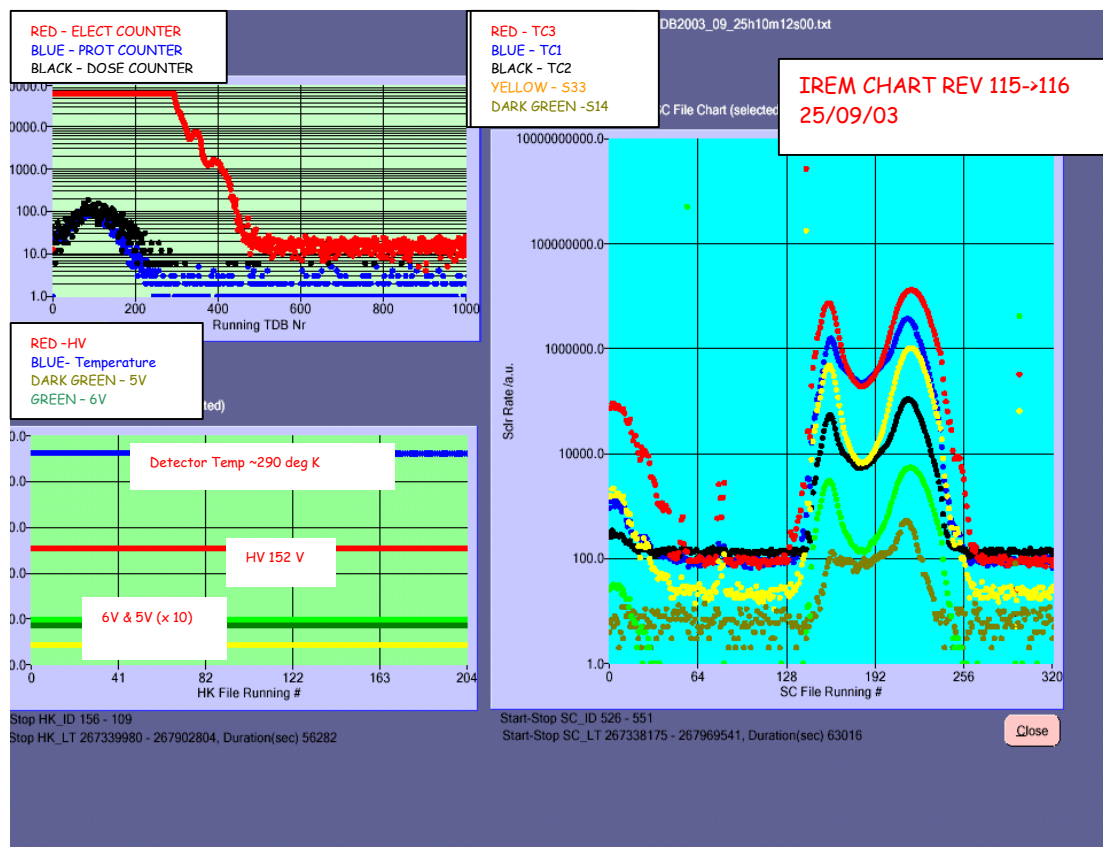


Updated 2003 Sep 26 23:56:03 UTC

NOAA/SEC Boulder, CO USA



The plots of the IREM count rates and statuses for the Belts passage in rev 115->116 (during the passage 114->115 the IREM ECOE was disconnected) are shown below:



Acknowledgment to the IREM team for use of the IREM ECOE@MOC

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Date : 29/09/03

Issue : 1
Rev. : 0
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8.4 List of Anomalies since Launch

The list of pending anomalies is under review.