Evaluation of Tests of SIAM version 7 during Revolution 185

XMM-CAL-TN-??

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1 Introduction

We compared the pointings with the SIAM v7 with those of previous observations which were using SIAM v5.

In the following we use rotations around spacecraft axis (R_y, R_z) for the specification of shifts. All differences are given as rotations of the spacecraft starting from a pointing derived by using SIAM v5 and then rotating by R_y and/or R_z such that the current position is derived.

$$R_y > 0 \Longrightarrow \text{shift of detectors to } Z < 0 \Longrightarrow \text{shift of source in image to } Z > 0$$
$$R_z > 0 \Longrightarrow \text{shift of detectors to } Y > 0 \Longrightarrow \text{shift of source in image to } Y < 0$$

2 Measurements

The X-ray instruments used the observations of AB Dor, while for the OM BPM 16274 was used (two observations).

The results of the measured shiifts are given in Tables 1 & 2.

Instrument	R_y (arcsec)	R_z (arcsec)
EMOS	27	-75
EPN	28	-80
RGS	28	-84
OM	20	-74

Table 1: Measurements of apparent satellite rotations from pointing with SIAM v5 to pointing with SIAM v7.

It is not understood why the R_z of the MOS and R_y for OM are systematically outside the remainder of the measurements.

These measurements are consistent within a few arcses with the input that went into the generation of this SIAM matrix, which is given here for completeness:

Instrument	R_y (arcsec)	R_z (arcsec)
EMOS	59	-7
EPN	58	-12
RGS	64	-13
OM	56	-10

Table 2: Measurements of apparent satellite rotations from pointing with SIAM v5 to pointing with SIAM v7. Prime instrument was RGS.

Prime Instrument	R_y (arcsec)	R_z (arcsec)
RGS1	$+53.6$	-15
EPN	$+20$	-80

Table 3: Inputs for calculation of SIAM v7. Numbers are additional apparent rotations of the satellite w.r.t. the pointings generated from SIAM v5.

The shifts of R_y appear to be systematically larger than was intended. With the absence of the actual attitude histoR_y file, we cannot judge whether this is not due to a real offset in the pointing. Similarly the shifts of R_z for RGS prime appear slightly lower than requested. Again the attitude histoR_y file would be required to track this down.

The most critical item is the small window of the MOS camers, which have a width of 100×100 arcsec, so these 10 arcsec errors at max are not considered a problem.

3 New SIAM version 8

While this tests proved that all s/w is correct for the generation of the SIAM matrix, it has also shown that the input of the requested offsets for the EPIC detectors was incorrect in sign. The both angles for EPN prime and the angle of R_z for RGS prime should have been inverted. We conclude that a new SIAM is required with the following specifications:

Prime Instrument	R_y (arcsec)	R_z (arcsec)
RGS1	$+53.6$	$+15$
EPN	-20	$+80$

Table 4: Inputs for calculation of SIAM v8. Numbers are additional apparent rotations of the satellite w.r.t. the pointings generated from SIAM v5.

Given this validation of the s/w, we feel confident that this SIAM can be generated, and no further test of the pointing is required.

4 Conclusion and Future Steps

Remaining byproducts of this test are the following observations:

- EMOS large window is ok
- EMOS small windows were not executed correctly and only one exposure of one camera was successfully obtained. This needs to be verified for the other small windows.
- execution of FAST window mode of EMOS was unsucessful – this probably needs an update of the mode parameters
- Filing of data on-ground, as delivered to ESTEC seems inconsistent

We suggest the following steps to be taken from here on:

1. calculation of new SIAM with above requirements
2. update of rudi5 window parameters for OM; this invloves a change of the ops d/b
3. use of this test SIAM during any RGS wavelength calibration observation

Following this, these items need to be completed:

- A validation of the rudi5/fast small window settings is required, but no dedicated test observation is needed here. The validation can take place based on rudi5/image data acquired after the SIAM was re-generated.
- similarly a validation of the EMOS small windows is required. This can be executed during any upcoming RGS wavelength calibration observation.
  There only the new SIAM should be used for RGS prime, only one pointing is required and only execution of the windows should be performed.

A Measurements with EPIC (DL)

A.1 with EMOS

OBSvn 0133120201 = PN prime

	EXPECTED		MEASURED	
	RawX	RawY	RawX	RawY
MOS 1	241	307	385	270
delta from previous boresight	−74	+15	+70	−22
MOS 2	286	227	331	370
delta from previous boresight	−15	−74	+30	+69

This means that the position has changed in Spacecraft Y by +70 (expected −74)
and in Spacecraft Z by +25 (expected −15)

OBSvn 0133120101 = RGS prime

	EXPECTED		MEASURED	
	RawX	RawY	RawX	RawY
MOS 1	296	243	321	239
delta from previous boresight	-19	−49	+6	−53
MOS 2	350	282	360	306
delta from previous boresight	+49	−19	+59	+5

This means that the position has changed in Spacecraft Y by +5 (expected −19)
and in Spacecraft Z by +56 (expected +49)

A.2 with EPN

Roughly consistent but with ~ 1 pixel error could be 4" wrong (actually the R_y for the RGS prime pointing is in better agreement with the measured values by the RGS and the OM than with the MOS !)

PN Boresight has shifted Z +28 ", y +80"

RGS boresight has shifted Z +58", y +12"

B Measurements with RGS (CE)

I measured the position of the O VII transition on the detector for pointings with SIAM v5 (current operational) and compared its shift with SIAM v7.

	RGS1		RGS2	
	BETA (radians)	XDSP (radians)	BETA (radians)	XSDP (radians)
SIAM 5	5.663e-2	-1.2113e-6	5.670e-2	-6.076e-5
SIAM 7, RGS:	5.680e-2	6.010e-5	5.687e-2	9.509e-6
SIAM 7, EPN:	5.670e-2	4.054e-4	5.678e-2	3.473e-4

This implies the following rotations in the s/c coordinate system w.r.t. a pointing with SIAM v5:

for RGS prime

	R_y	R_z
from RGS1	64.5	-12.6
from RGS2	64.3	-14.5

for EPN prime

	R_y	R_z
from RGS1	26.5	-83.9
from RGS2	30.2	-84.2

C Measurements with OM (RM)

measured:
PN Boresight has shifted Z +18.9", y +74.5"
RGS boresight has shifted Z +56.1", y +9.9"

expected according to SIAM:
PN Boresight has shifted Z +15.1", y +77.9"
RGS boresight has shifted Z +52.3", y +14.1"

The difference between the measured and expected gives an estimate on the accuracy of s/c pointing (and calculation).

D Remarks and Conclusion of OM (RM)

The measured target position had an offset from the expected target position of 5.1 arcsec for the RGS prime observation and 5.7 arcsec for the EPIC pn prime observation. Such an offset would be critical for the operation of small windows, such as fast mode windows. However FAQ should compensate for such offsets once fully operational and if executed. During the test observation no FAQ took place, as the OM images were acquired in engineering mode 4 and no experience on the FAQ under these circumstances was gained.
The procedure of the window position calculation was confirmed by the test observations and a repetition of the test is not required after the re-generated SIAM including the required correction, because the accuracy of 5 arcsec is sufficient for the rudi5/image configurations, especially that FAQ is supposed to correct for this offset.

The new rudi5/image configurations will be re-calculated for the re-generated SIAM in an identical way as for the boresight test. No additional test is required.
A validation of the rudi5/fast small window settings is required, but no dedicated test observation is needed here. The validation can take place based on rudi5/image data acquired after the SIAM was re-generated.

E Comments about EMOS Data (DL)

While the main goal at the moment is to verify the pointing is correct, I briefly make some observations about the MOS readout modes as found in the odf files. There are a number of discrepancies. the FULL frame modes not having changed have been used to verify pointing. Windowed modes discussed as follows:

First of all as the exposures are mostly unscheduled it is difficult to match intended exposure # with the unscheduled one:

OBSVN 0133120101 RGS Boresight test

- MOS1 exposure U003 — probably supposed to be S007 — small window. NO VALID DATA IN THIS FILE
- MOS1 exposure U004 — probably supposed to be S009 — large window. Range of window values $\sim$ 145–446 in X and 94–389 in Y. This is consistent with what was expected
- MOS1 exposure U005 — there should not have been another windowed exposure — should have been timing. Reported data comes at windows 145-446, 93-390 so it is another large window exposure!
- MOS2 exposure U003 — probably supposed to be S010 — large window Range of events in window 200–500, 133–499, BUT NO EVENTS IN THE RANGE 197–319
- MOS 2 exposure 5 — could also have been S010 — large window — range of events 199–500, 132–429 — consistent with expected range
- MOS2 exposure U011 — could have been S011 (timing) but then it has been mis-associated to MOS 2 not MOS 1. range of window 303–393 is consistent with MOS2 — but are there 10 pixels missing Tony ?

- MOS2 exposure U012 could have been S012 (timing) — again consistent with MOS2 timing mode but 10 pixels short?

7 EXPOSURES 4 of which are failed or inconsistent data in pmsfits files!!!

OBSVN 0133120201 PN Boresight test

- MOS1 exposure U003 — probably supposed to be S010 — lareg window. Range of window values 81–382,157–454 consistent with MOS1 large window
- MOS1 exposure U011 — probably supposed to be S011 — timing mode. Range of window values 261–351 is NOT CONSISTENT WITH NEWLY EXPECTED LOCATION. Also appearance is rather "blobby"
- Other MOS 1 exposures not found
- MOS2 exposure U003 — probably supposed to be S010 — large window Range of events in window 135–436, 71–368 — consistent with expected range
- MOS 2 exposure U012 — could have been S012 (timing) — NOT consistent with new MOS2 timing mode location
- Other MOS 1 exposures not found

6 window exposures expected — only 2 seem consistent