XMM Optical Monitor

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Test Report for XMM-OM Software release 10

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CHANGE RECORD

Issue	Date	Changes
1	15-May-00	First version

Contents

1 Introduction

This is the Test Report for release 10 of the ^{XMM}OM software. It describes the tests performed to check the functionality of the on-board software and the remaining tests to check the fixes for NCR and ECR software changes.

2 Reference Documents

- **XMM-OM/MSSL/ML/0006** ^{XMM}OM VxWorks Command Summary (FM Model) (http://xmmom.mssl.ucl.ac.uk/docs/xmm-om/mssl/ml/0006/)

- **XMM-OM/MSSL/ML/0009** ^{XMM}OM User Manual (FM) - Part 2: Experiment Operations Procedures http://xmmom.mssl.ucl.ac.uk/docs/xmm-om/mssl/ml/0009/ops.ps.gz

- **XMM-OM/MSSL/SP/0207** OM FM Software Testing at MSSL (http://xmmom.mssl.ucl.ac.uk/docs/xmm-om/mssl/sp/0207/icu_fm_testing.ps.gz)

- **XMM-OM/UCSB/TR/0002** DPU Flight Software Test Report (http://xmmom.mssl.ucl.ac.uk/docs/ucsb/UCSB_TR_0002.ps.gz)

3 Overview

This document describes the software testing done to check the ^{XMM}OM flight code and to check the NCR and ECR fixes.

The general testing philosophy and test equipment is described in the “OM FM Software Testing at MSSL” document XMM-OM/MSSL/SP/0207 (http://xmmom.mssl.ucl.ac.uk/docs/xmm-om/mssl/sp/0207/).

Because of the statistical nature of possible timing problems in real-time, it is not enough to run a particular exposure. To have good confidence that such exposures would run for a whole orbit, they must be tested for a total time which is considerably longer than one orbit.

The tests were carried out over a 2 week period.

4 Abbreviations

CPU	Central Processor Unit
CVS	Concurrent Version System
DEM	Digital Electronics Module (consists of the DPU and the ICU)
DPU	Digital Processing Unit (supplied by the USA team)
ECR	Engineering Change Request
EOB	Electro-Optical Breadboard
ESA	European Space Agency
FAQ	Field Acquisition
GS	guide star(s)
HK	Housekeeping
HV	High Voltage
ICU	Instrument Control Unit (supplied by MSSL)
IFT	Integrated Functional Test
KAL	Keep Alive
LANL	Los Alamos National Laboratory
LUT	Lookup Table
MCP	Microchannel Plate(s)
MSSL	Mullard Space Science Lab (University College London)
NCR	Non-Conformance Report
OM	Optical Monitor
RBI	Remote Bus Interface
SNLA	Sandia National Laboratory
SOC	Science Operations Centre
TMPSU	Telescope module power supply unit
UCSB	University of California at Santa Barbara
XMM	X-ray Multi Mirror Mission
s/c	spacecraft
tc	Telecommand
tm	Telemetry

5 Typographical and Other Conventions Used in this Document

5.1 Typographical

- Running text appears in this normal Roman font.
- *Italic font* will indicate something (*e.g.*, a parameter) that should not be taken literally.
- A `"typewriter" font` will be used to indicate Unix/VxWorks commands.

6 Equipment

All tests at MSSL were performed on the Flight Spare DEM. All tests at SNLA were performed on EOB2.

The MSSL configuration for the tests is the Electronic Ground Support Equipment (EGSE) connected to the flight spare DEM hardware system. The hardware configuration includes a Sun networked via ethernet to a dedicated Force VME processor card running VxWorks housed in a VME bus card cage. Also in this card cage are cards to simulate the spacecraft. The flight spare DEM is thought to behave almost identically to the flight units.

The SNLA configuration is similar but has EOB2 instead of the flight spare DEM. EOB2 has different timing characteristics to the flight units.

The input data is produced either by a QM detector or a fast PC OM1-simulator.

7 Synchronize software

Version control is maintained using the CVS software.

MSSL updates SNLA/LANL with the latest MSSL CVS modules of (the egse) "scripts", the "egse" (code) & ICU uploadable flight "oper" code. UCSB/SNLA/LANL updates MSSL with the latest UCSB CVS modules of the DPU uploadable flight code "white", "blue", "red", "include", "dpu/util".

8 Tests Performed

The tests are performed with both the fast PC OM1-simulator and the QM detector. Each of these test platforms has their own strengths and weaknesses. All science mode tests included fast mode windows to check fast mode operation.

8.1 Tests with fast PC OM1-simulator

Long soak tests were performed with the PC OM1-simulator. The use of the PC OM1-simulator allows realistic scripts to be run with changing window configurations and changing filters, together with a realistic drift to test the "Accumulate and Track" mode. The simulator does, however, generate uneven photon event streams since it is not possible to generate photons in real time at a sufficient rate. Typical gaps in the photon stream range between 10 and 40 ms).

The input data to the PC simulator is APM (Automatic Plate Measuring) data from the Digitised Sky Survey which allows the input of stars and galaxies (parameterised by an elliptical function) down to approximately 21st magnitude. Estimates of the stars' spectral type were made from the APM colours (E and O) with extended sources having a galaxy spectrum. In running the tests a number of different star fields were used including a cluster field with a large number of extended sources. The exact list of fields used for these tests are given in table 1. The drift used was approximately representative of the behaviour of the spacecraft, and an example of a drift history file is shown in figure 1. The current simulator tests do not include any strong background features as seen with the inflight detector, but these have not caused any problems with the current on-board software.

Tests using the simulator were performed both at MSSL and at SNLA.

8.2 Tests with QM detector

Test have also been run with the QM detector at MSSL together with a light source with a star mask. The use of the QM detector allows tests to be performed with the real hardware, so ECRs 86, 88 and 89 and NCRs 192, 194 and 195 were tested using the QM. Procedures such as the high voltage turn on and off were also tested. The QM has the further advantage that is uses real photon data so there are no gaps in the photon event stream, which is particularly useful for testing fast mode data. However, the point spread function of the sources was found to be too large to allow tracking, which is invariably turned off by the DPU during the tests. Figure refeng4 shows the image generated by the star mask.

9 Summary of the tests

9.1 Engineering Modes

The following modes were tested:

9.1.1 Engineering mode 3

Tested using the QM detector using script `eng3`. No problems seen.

9.1.2 Engineering mode 4

Tested using the QM detector using script `eng4`. The original script had an error in the timing of the initial tc_init_dpu command. The original timing (25 s) could lead to a conflict with the next commands (filter wheel moving). The time was increased to 50 s which removed any problems with the exposure. This timing is already corrected in the flight procedures used in orbit with the real spacecraft.

9.1.3 Engineering mode 5

Tested using the QM detector using script `eng5`. Again, the original script had an error in the timing of the initial tc_init_dpu command. The original timing (25 s) could lead to a conflict with the next commands (filter

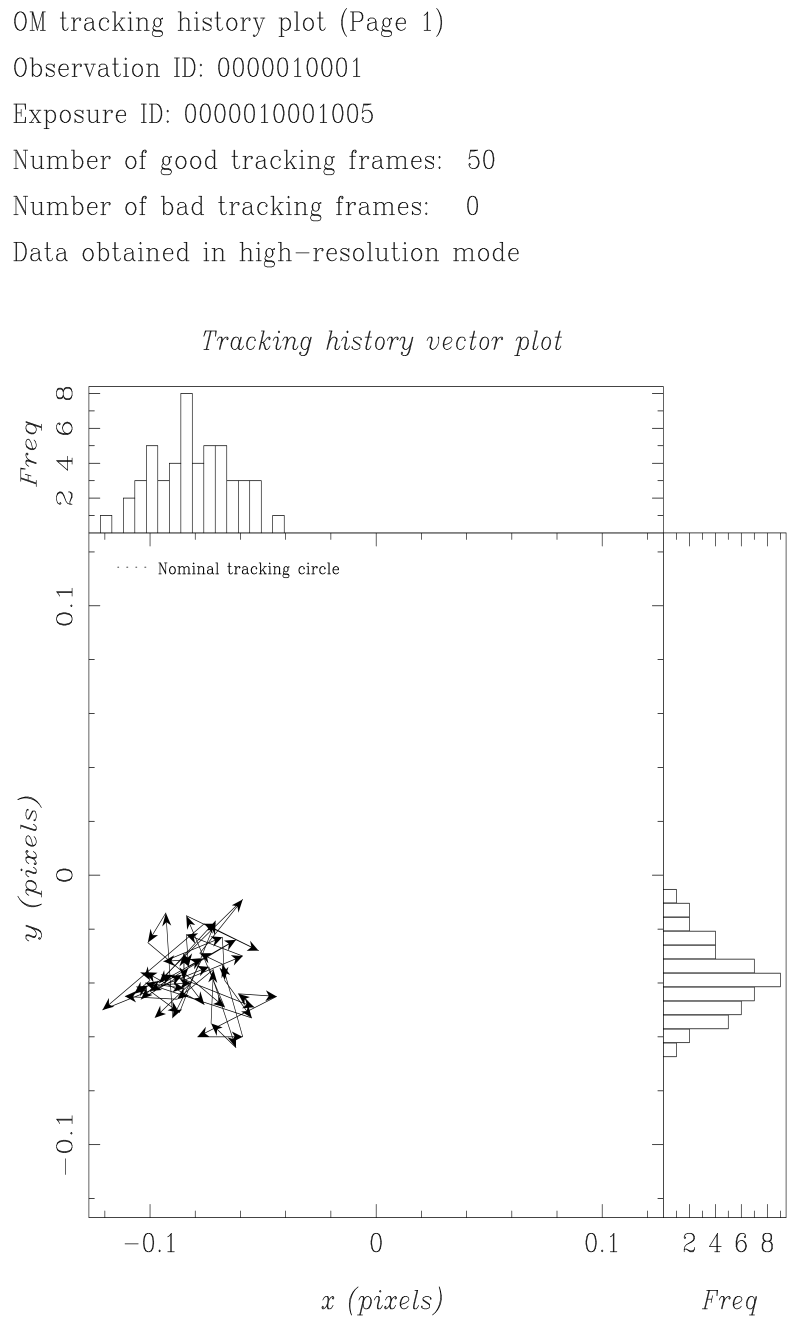


Figure 1: A typical tracking history used by the PC OM simulator

Field Name	Number of Exposures	Total Exposure time (hr)
3C273	89	28
Her1720+50	257	80
Abell 3195	5	1.5
QM	174	54
TOTAL	525	163.5

Table 1: List of fields, number of exposures and exposure time for the tests

wheel moving). The time was increased to 50 s which removed any problems with the exposure. This timing is already corrected in the flight procedures used in orbit with the real spacecraft.

9.2 Science Exposures

Science exposures were performed with the PC OM1-simulator testing “Choose Guide Stars” and “Accumulate and track”.“Choose Guide Stars” and “Accumulate” were tested also with the QM detector.

9.2.1 General Comments

All images were checked for artifacts and features, and the fast mode data were checked for the occurrences of NCR 186. Here we note that such an error in the base in fast mode is already fixed by the ground segment software without any loss of scientific information. Throughout the tests it was always found that the magnifier code generated many A5B2 and A5AD exceptions (GADE_RANGE_ERROR and GADE_RSIAL_ERROR) during the `cgs` script. A problem highlighted by the large number of errors generated by the magnifier was the way large numbers of errors were buffered in the SSI leading to apparently spurious exceptions in the filter following the magnifier. The UV filters (UVW1, UVM2, UVW2) always generated A5FF (zero background) and A5D7 (no good guidestars) during the `cgs` script which again is expected for the UV filters. In these cases tracking was turned off correctly and there was no effect on the output data.

9.2.2 Field 3C273

This was a test with the starfield of 3C273 generated by the PC OM1-simulator. Figure 2 shows the input APM data for the field and Figures 3 and 4 show both the V band and UVW1 simulated data covering the whole field obtained from the SAS OM pipeline. The 5 windows used during the exposure are clearly seen. In total 89 1000 s exposures were taken over approximately 28 hr, cycling through the rudi-5 window configurations and looping over all the filters. Three exposures out of 89 showed the error in the base (NCR 186).

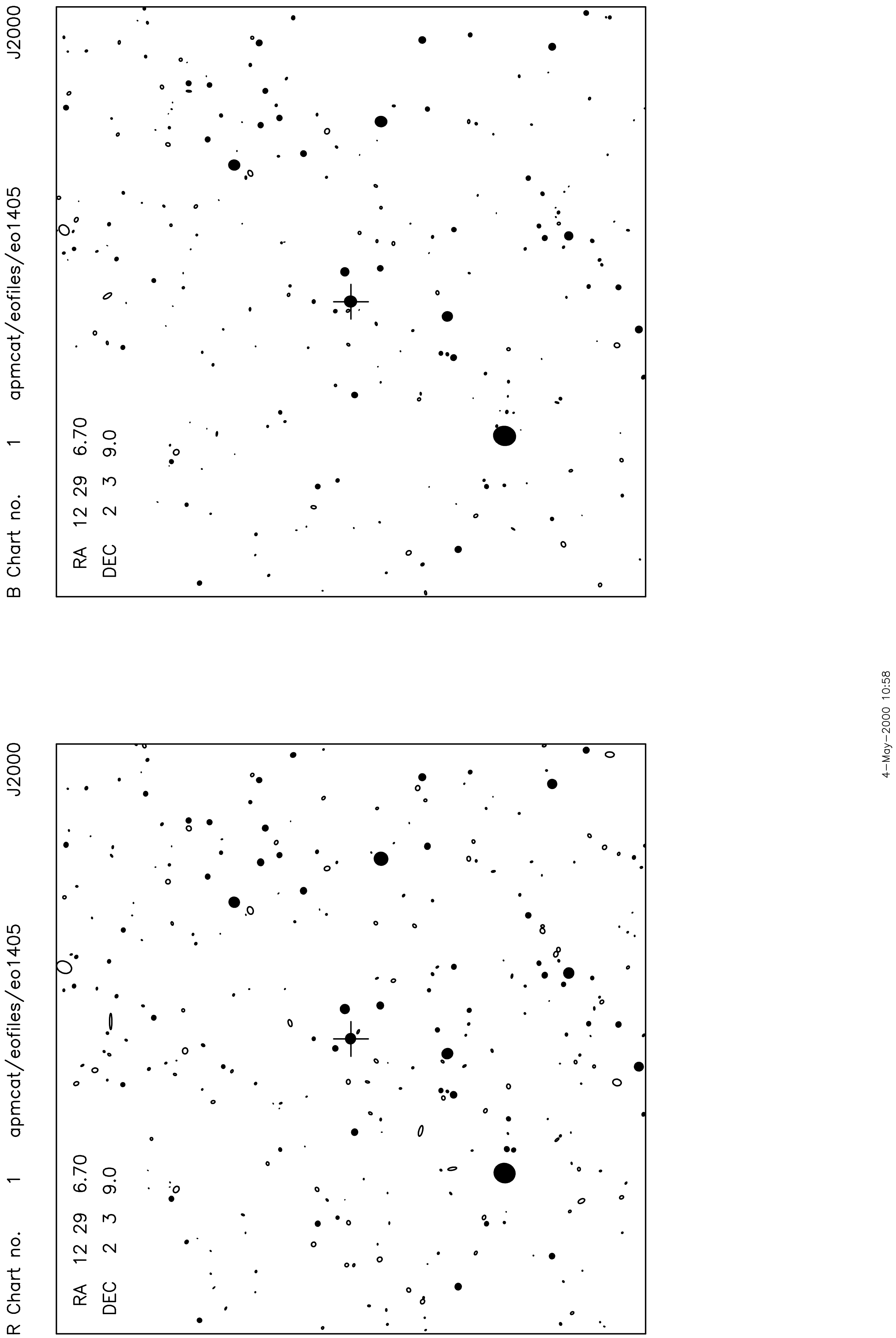


Figure 2: The APM input data for field 3c273

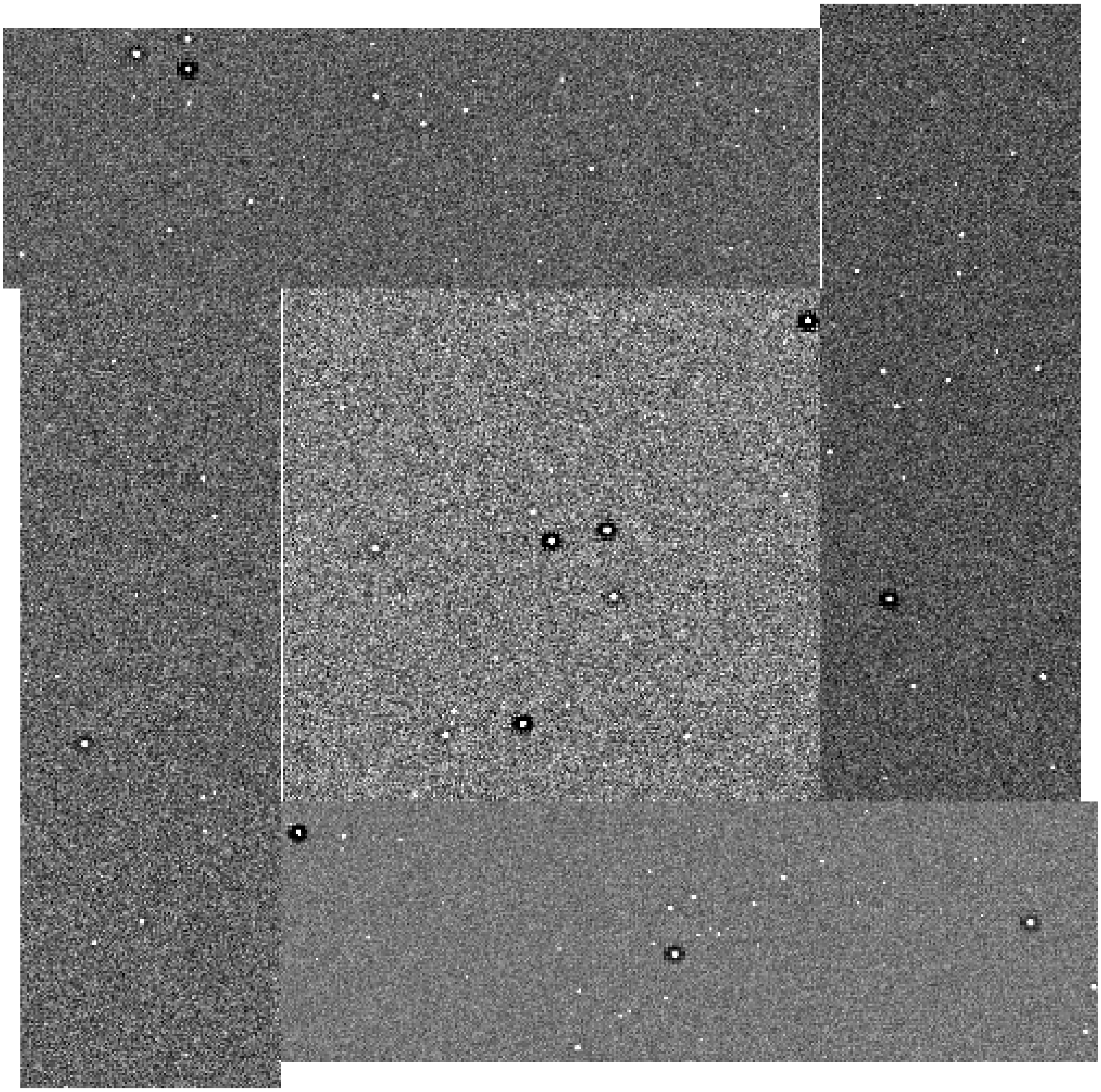


Figure 3: Simulated data after processing through the OM pipeline for 3c273 in the V filter

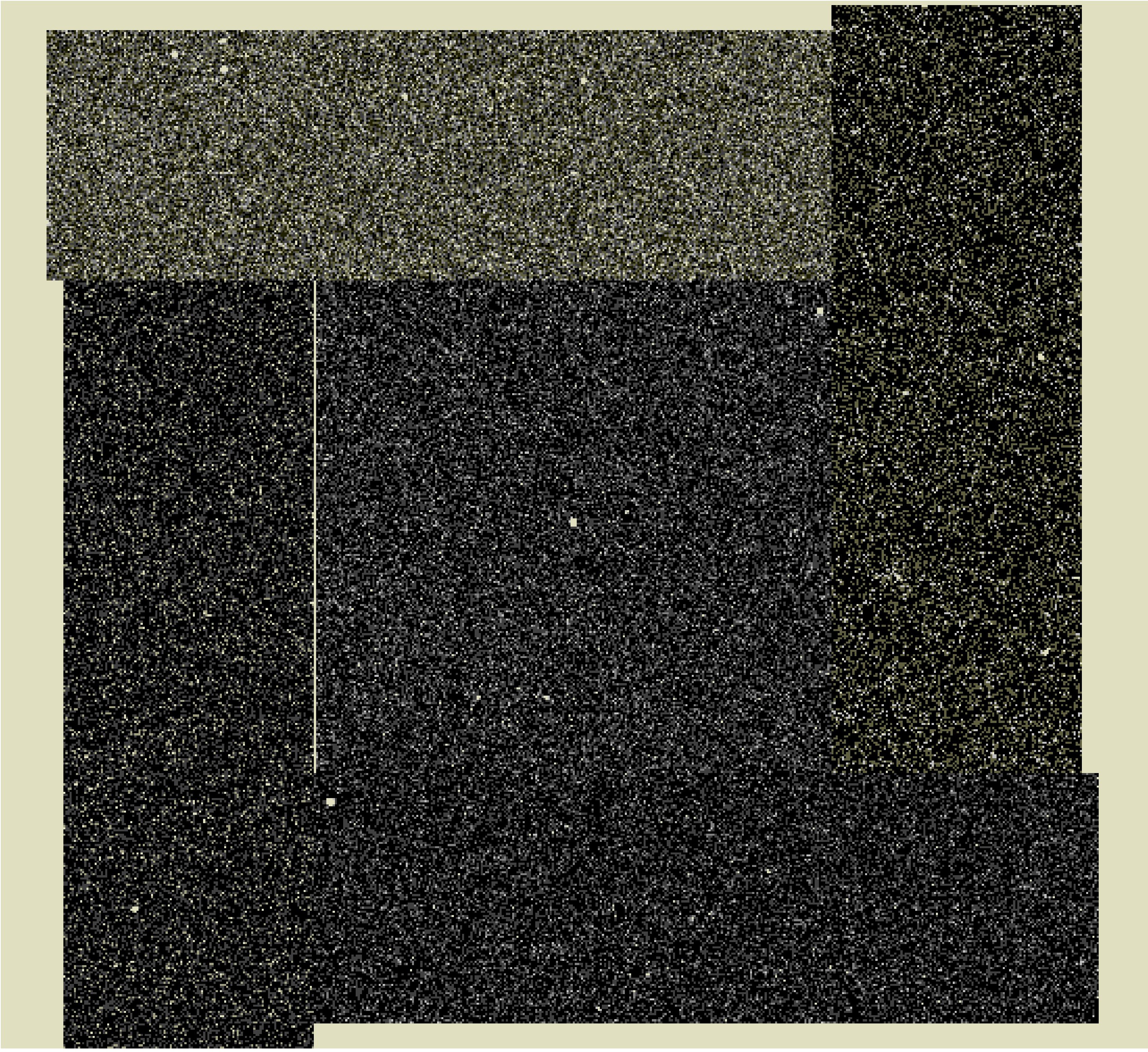
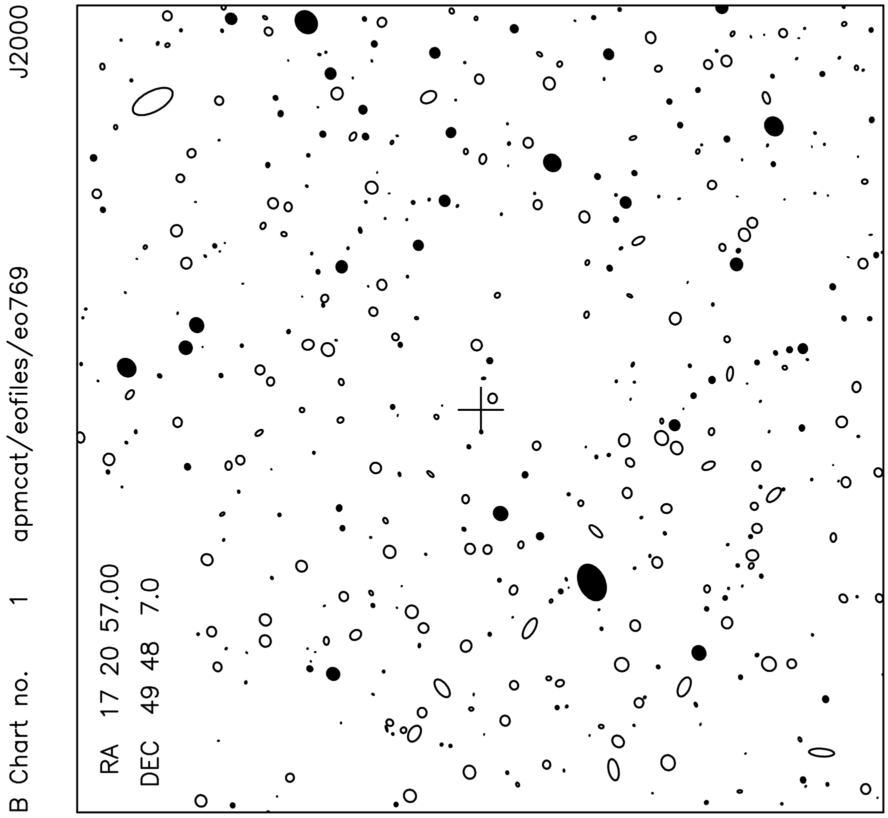


Figure 4: Simulated data after processing through the OM pipeline for 3c273 in the UVW1 filter



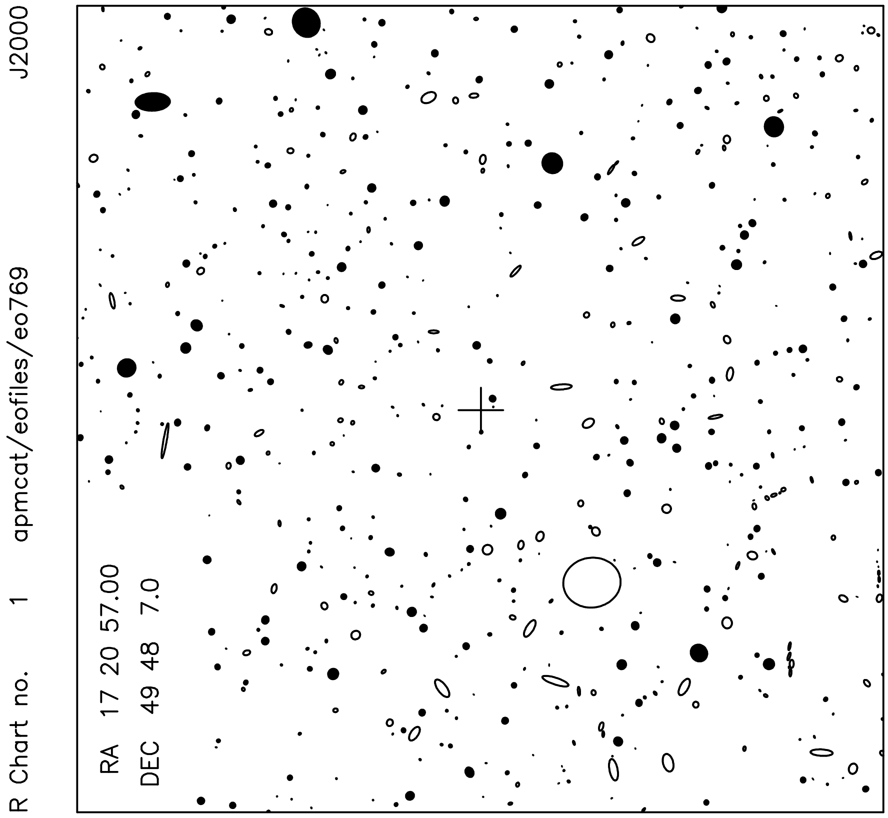


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Figure 5: The APM input data for field Her1720+50

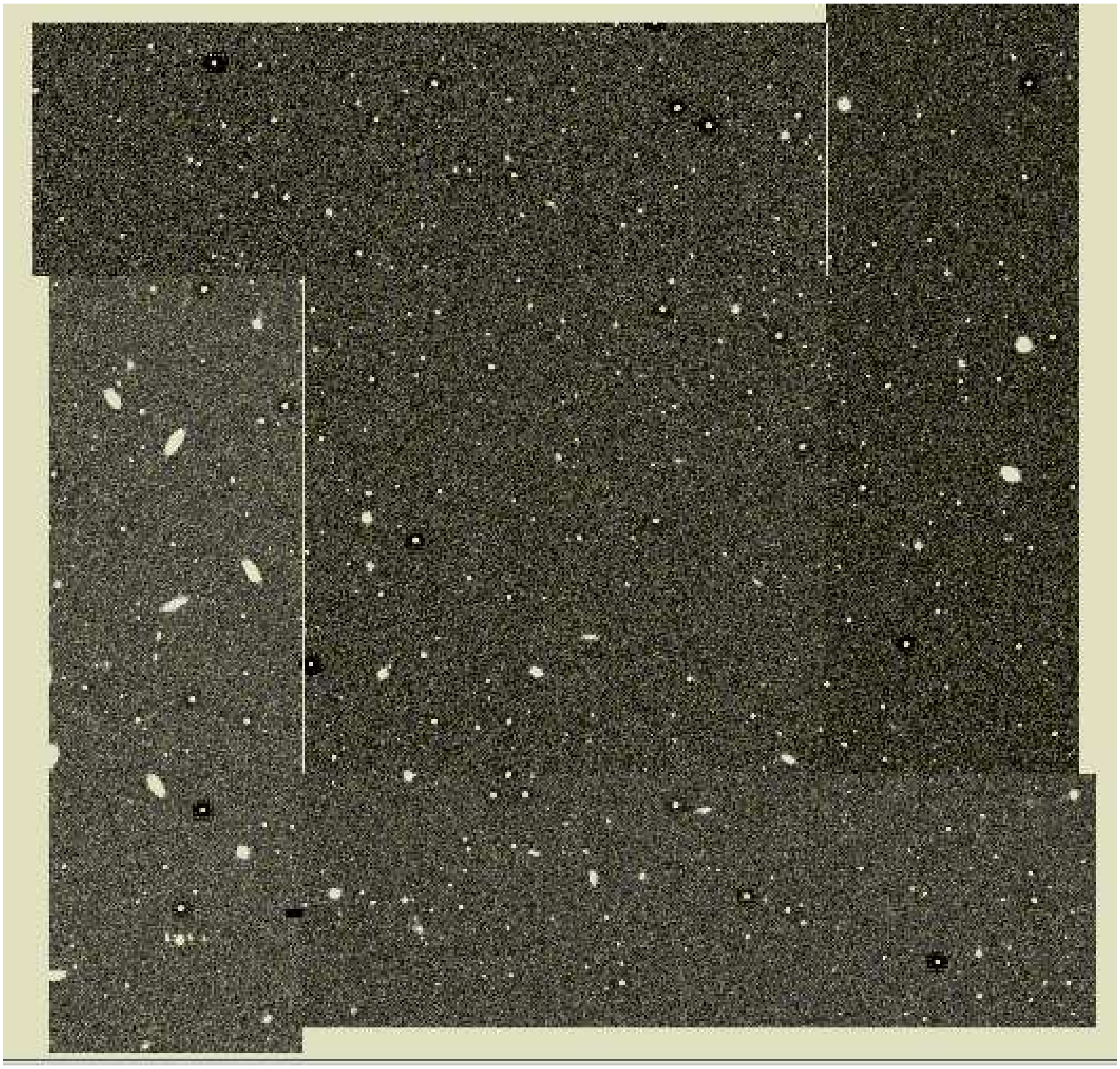

Figure 6: Simulated data after processing through the OM pipeline for Her1720+50 in the V filter

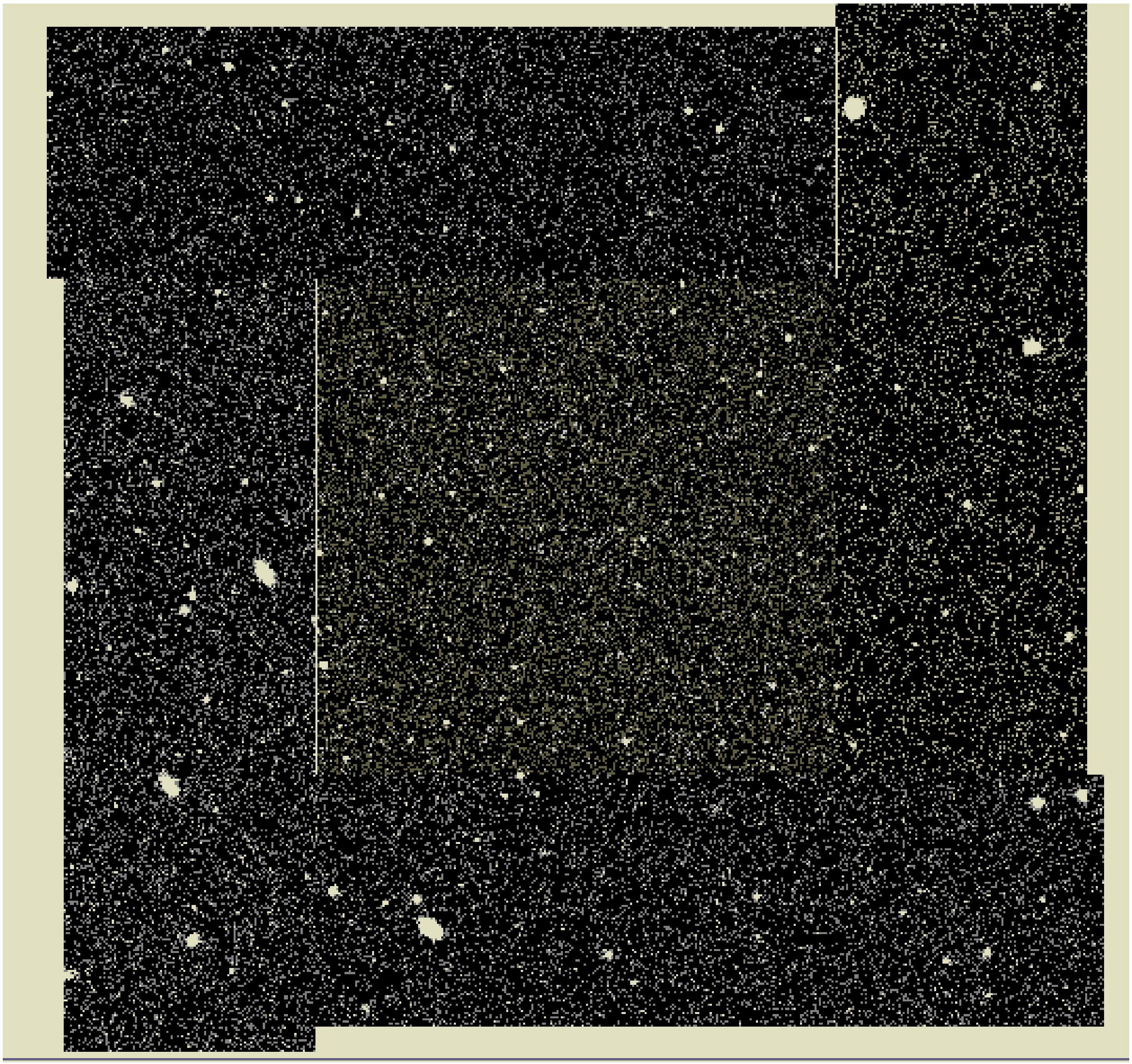

Figure 7: Simulated data after processing through the OM pipeline for Her1720+50 in the UVW1 filter

9.2.3 Field Her1720+50

This was a test with the starfield of Her 1720+50 generated by the PC OM1-simulator. Figure 5 shows the input APM data for the field and Figures 6 and 7 shows both the V band and UVW1 simulated data covering the whole field obtained from the SAS OM pipeline. The 5 windows used during the exposure are clearly seen. In total 257 1000 s exposures were taken over approximately 80 hr, cycling through the rudi-5 window configurations and looping over all the filters. The same checks were performed on this field as were done for 3c273. 150 out of the 251 exposures showed base errors. This large number is almost certainly due to the fact that there were no stars in the fast mode window so is different from NCR 186. This problems has been flagged as a new NCR.

9.2.4 Field Abell 3195

This was a test with the starfield of Abell 3195 generated by the PC OM1-simulator. Figure 8 shows the input APM data for the field and Figure 9 shows the V band simulated data covering the whole field obtained from the SAS OM pipeline. The 5 windows used during the exposure are clearly seen. This is the field used to test NCR 184 since this field has many bright, large extended sources. The test was done only using the V filter (5 exposures) and the same checks were performed on this field as were done for 3c273 and Her1720+50. In this case the exposures generated A5D7 alerts (no good guidestars) even though there are clearly good guidestars in the field, which is the symptom of NCR 184.

9.3 QM test

The image used in the QM tests is shows in Figure 10. Because of the lack of good stars in the field, the QM science tests were run with a single window configuration so we would always have stars in fast mode windows. The window configuration is shown in figure 11. Also, no good guide stars could be found in the QM image so the DPU always turned tracking off.

The first overnight run gave an immediate A510, a spontaneous reset of the dpu, the only one that occurred during these tests. The second run took 174 1000 s exposures or approximately 54 hr running time. 12 out of 174 exposures showed the error in the base (NCR 186). Since with the QM there will be no gaps in the date stream, this is probably a more accurate estimate of the occurrence of NCR 186 than that given running the PC OM simulator.

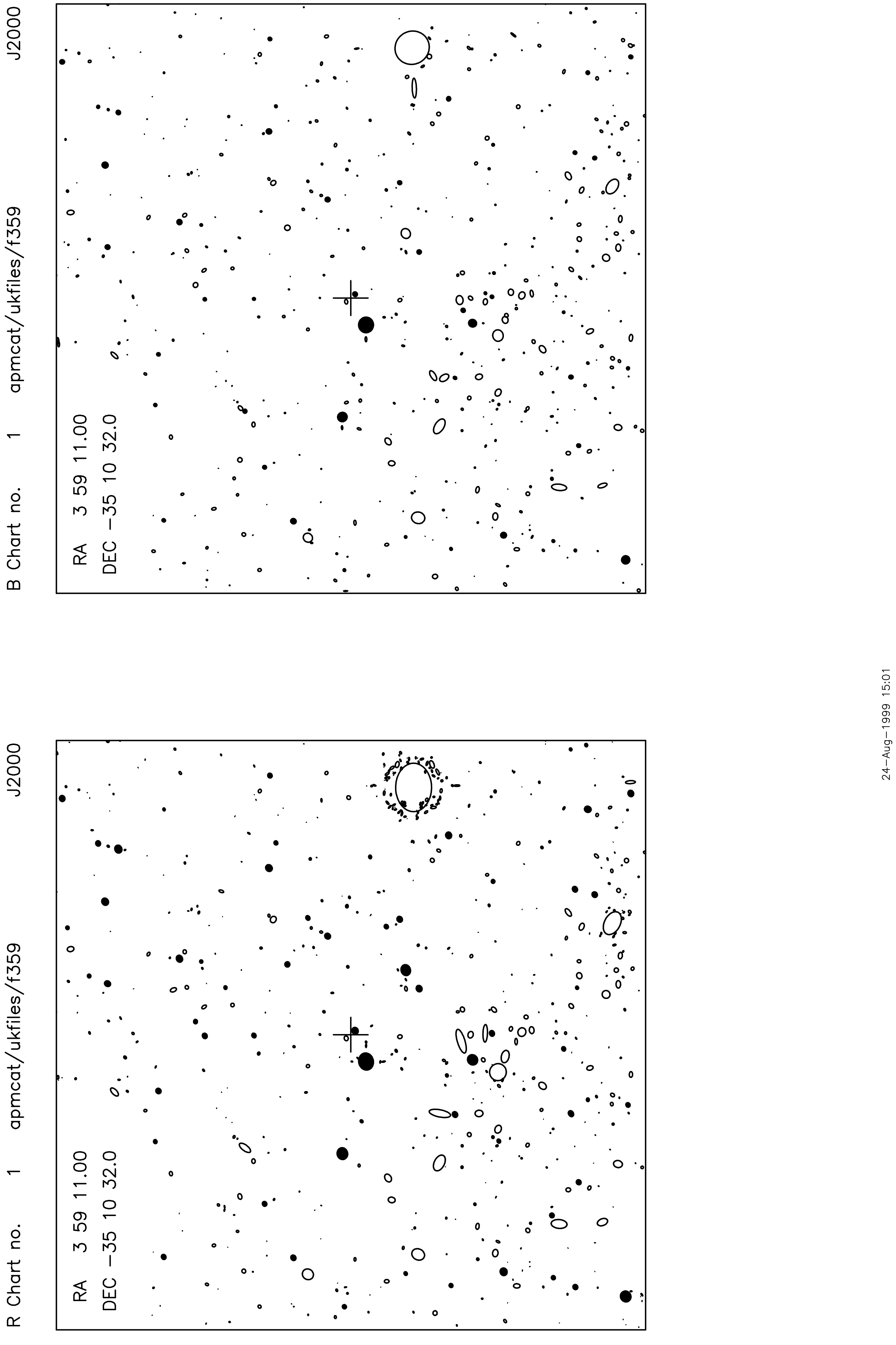

Figure 8: The APM input data for field Abell 3195

Figure 9: Simulated data after processing through the OM pipeline for Abell 3195 in the V filter

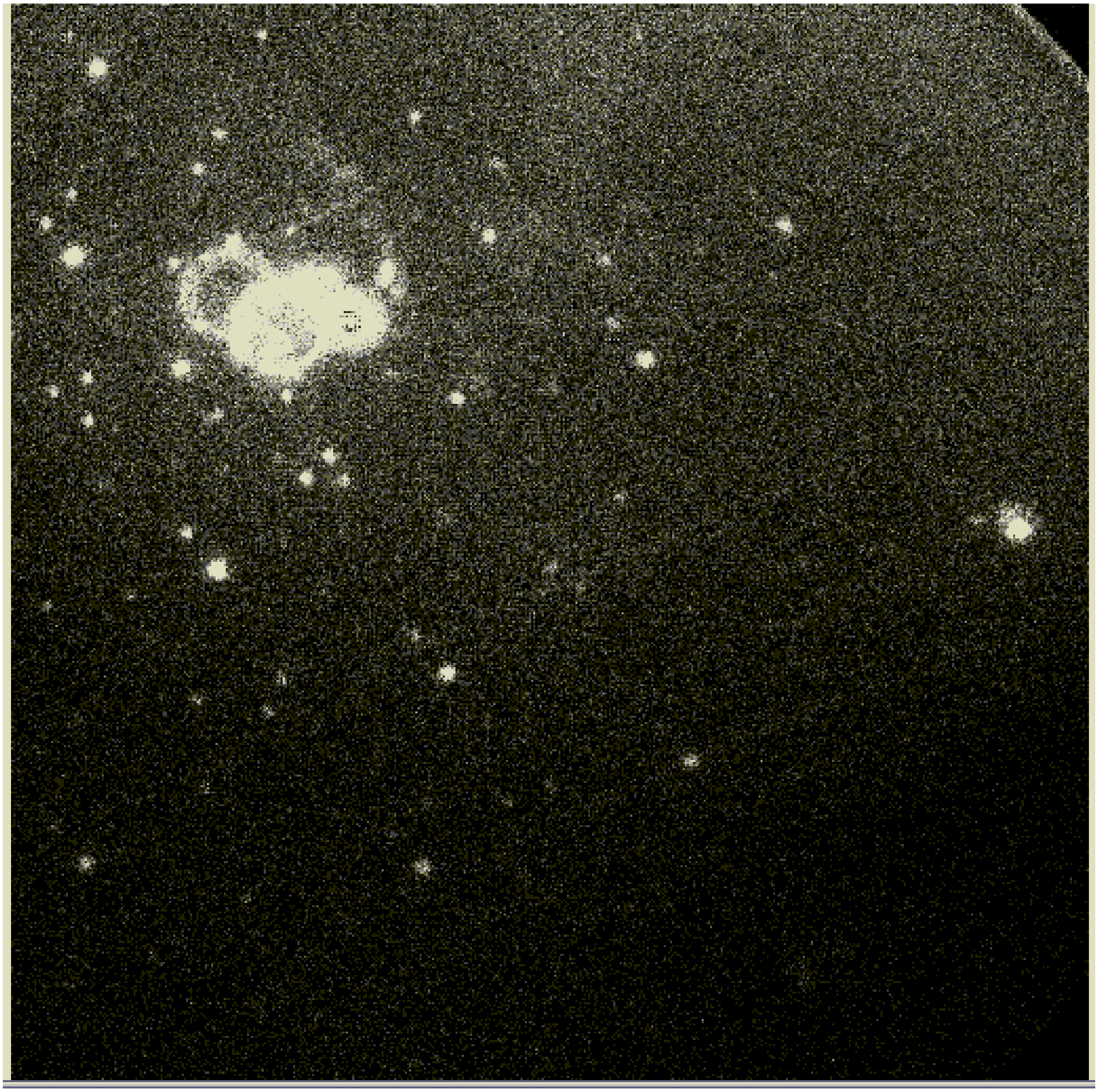

Figure 10: Star field generated by the QM

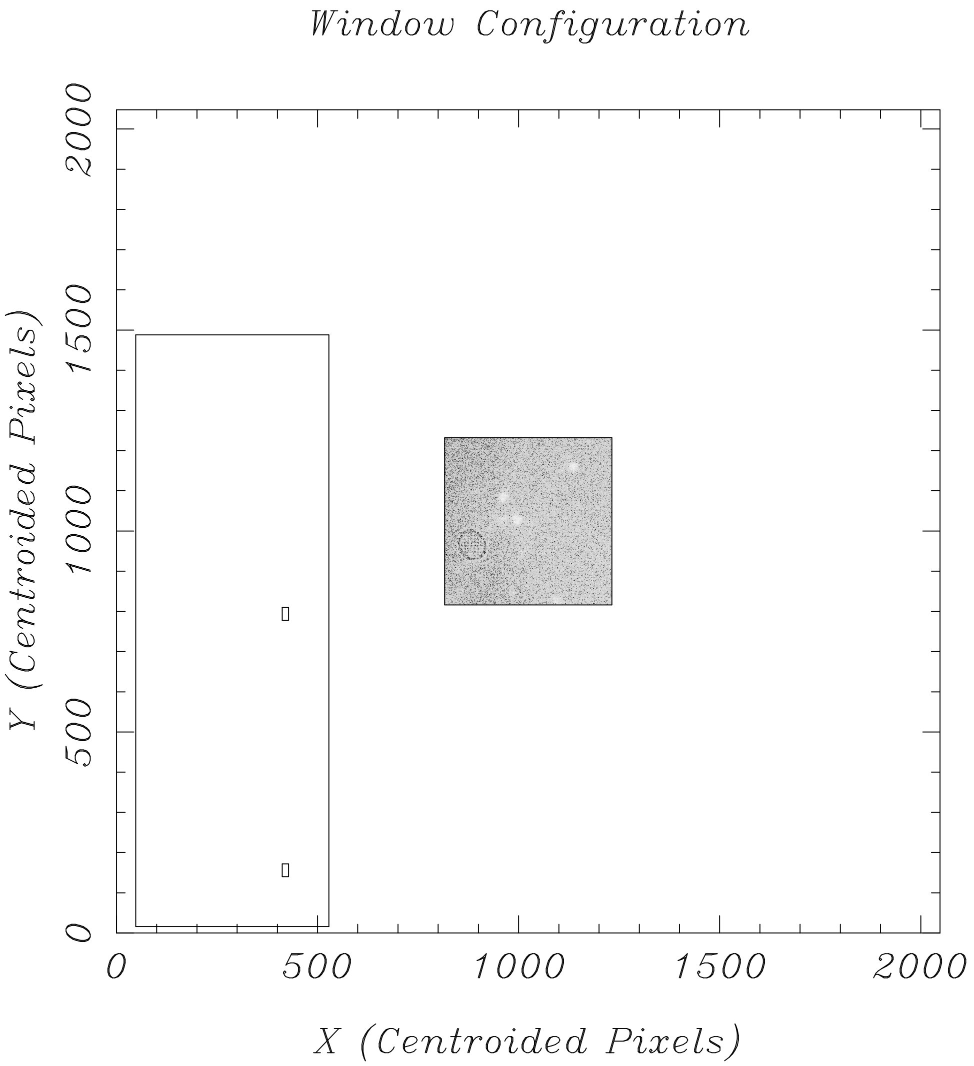

Figure 11: Window configuration from the QM tests. The two small windows in the left hand large window are the positions of the fast mode windows

10 Results of tests

The ECRs which were tested and which worked are **ECR 86, ECR 87, ECR 88 & ECR 89**. The NCRs which were tested and which worked are **NCR 183**, **NCR 187**, **NCR 188**, **NCR 192**, **NCR 193**, **NCR 194**, **NCR 195** & **NCR 196**. **NCR 185** & **NCR 191** could not be tested at MSSL. Under current operations **NCR 197** should not occur but is still open. **NCR 167 & NCR 186** are still open.

10.1 Science capability with release 10

10.1.1 Image modes

Apart from the magnifier (NCR 167) and NCR 184 (no guide stars found due to a largee number of bright extended objects in the field), all the image modes worked as expected. The magnifier had trouble during the choose guide star script (`cgs`) generating many alerts. This is currently under investigation. NCR 184 is still present but is an extreme observational case and is unlikely to happen often during operations.

10.1.2 Fast mode

Fast mode is working well enough to obtain science data. NCR 186 is still present at a reduced rate and has been effectively fixed by a change in the ground system software. NCR 186 affected 15 out of 263 1000 s exposures.

Two new NCRs have been identified associated with fast mode which will be allocated numbers in due course (see section 10.2.1).

10.2 New anomalies

A number of new anomalies have been seen during these tests. Two are associated with fast mode, and two are associated with DPU operations. They will be allocated numbers in due course.

10.2.1 Fast mode

Two new anomalies have been seen associated with fast mode:

1. The first causes a spontaneous reset of the DPU (A510). At the moment it is not clear what the cause of this is though it happens relatively infrequently. In these tests this was only seen once in approximately 160 hr of testing. Previous testing on earlier version of the code indicate that this NCR occurs randomly with no obvious period, with occurrence times of between 2,hr to over 100 hr.
2. The other NCR occurs when there is no star in the fast mode window which causes the 16 bit fast mode memory to overflow. Since operationally you would expect to have a star in the fast mode window this is

unlikely to happen often but there are plans to implement fast mode using 24 bit memory which would solve this problem.

10.2.2 DPU operations

Both of these are associated with missing alerts.

1. After a LOAD_DPUOS command there is no corresponding DA_DPUOS_READY alert (A511) although the DPUOS is loaded correctly based on the housekeeping.
2. After an INIT_EXP command there is no corresponding DA_EOT_INIT_EXP (A523) alert.

11 Test Reports

These reports are detailed reports on specific ECRs/NCRs.

11.1 Test report for ECR 86

Purpose of tests

To check that tc_mode 2 when already in mode 2 is not considered an error. Similarly for modes 1, 3, 4 and 5

Test Location

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

Changing to one of modes 1 thru 5 when already in that mode is not flagged as an error.

Tests performed

Commands send to place OM in each mode 1 thru 5 and then repeated.

Results

No errors reported. All mode changes as expected. In addition, a repeated tc_mode 1 (go to safe) always issued a 'F/W at requested position' even though, by the second call, it was already at blocked.

Codes affected

modeman.adb version 1.11

Performed by: HEH at MSSL

11.2 Test report for ECR 87

Purpose of tests

To check that TMPSU and Detector exceptions have been correctly redefined as Major Anomalies.

Test Location.

MSSL

Test environments

Telescope Module Simulator
FS DEM

Expected results

All error messages should be of the Major Anomaly type.

Tests performed

A) Detector Electronics Table Loading.

1. reset ICU
2a. Modify ICU code (module detdigital.adb) such that any table loading operation will always return a 'failed' error condition
2b. Load Modified ICU code
3. Go to Safe.
4. Place f/w in blocked position
5. Go to idle
6. Sent commands to load Window Lookup table with 4 low res windows covering the whole detector
7. Received Major Anomaly message (error code 11 hex) as expected.
8. Sent commands to load Centroid table with equal channel boundaries
9. Received Major Anomaly message (error code 10 hex) as expected.
10. Modify ICU code back to correct version, reset and reload.
11. Repeat steps 1 through 8 but confirm that Event report with event codes 11 and 10 hex respectively were received, thus confirming the code had been correctly returned to its original state.

B) Loss of Dichroic or Filter Position

0. Test Report of NCR 195 confirms correct Major Anomaly report on the Loss of Filter Wheel position.
1. reset ICU
2a. Modify ICU code (module mechanism.adb) such that any dichroic moving operation will always return a 'failed' error condition

2b. Load Modified ICU code
3. Go to Safe.
4. Place f/w in blocked position
5. Go to idle
6. Go to Engineering mode
7. Sent commands to move dichroic to opposite position
8. Received Major Anomaly message (error code 61 hex) as expected.
9. Modify ICU code back to correct version and reload.
11. Repeat step 1 through 8 but confirm that Event report with event codes 61 hex weas received, thus confirming the code had been correctly returned to its original state.

Results

All Major Anomalies and Event Messages issued as expected.

Codes affected

detdigital.adb version 1.23 mechanism.adb version 1.27

Performed by: HEH at MSSL

11.3 Test report for ECR 88 part 1

Test report for ECR88 part 1:

Purpose of tests

To check that the ICU automatically safes the instrument in the event of loss of filter wheel position.

Test Location

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

The instrument should be in safe at the end of the test sequence.

Tests performed

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Filter Wheel moved to Datum—HK checked to validate.
8. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and F/W at requested position packet issued.
9. Command sent to go to Idle mode—command accepted.
10. Sent commands to ramp mcp23 to 100 V—HK confirmed that mcp23 ramped up to expected value.
11. Issued instructions to move filter wheel to the B filter position (Filter Number 4).
12. Immediately issued a series of DPU command with a code of A400 hex. This is in the valid TID range for the DPU and so is forwarded by the ICU to the DPU. However, it is not a valid DPU command and leads to the issuing of a series of 'Bad Command' error messages.
13. The above 'bad command' messages cause an expected 'Loss of filter wheel position' major anomaly report message (code 60 hex) due to the activity on the SSI.

14. The expected major anomaly report followed—Automatic Safe Transition, code 63 hex—was issued after about 5 s.

15. Monitoring of HK indicated that the instrument was in safe, the filter wheel blocked and the HV was at zero.

Results

All messages issued as expected. Instrument was in safe at end of above sequence.

Codes affected

mechanism.adb version 1.27

Performed by: HEH at MSSL

11.4 Test report for ECR 88 part 2

Purpose of tests

To check that it is not possible to move from safe to idle mode without the filter wheel being in a known blocked position.

Test Location

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

Unsuccessful Execution with error code of 135—Filter Wheel not at blocked—should be issued upon any attempt to move from Safe to Idle without first ensuring that the filter wheel is at blocked.

Tests performed

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown - as expected at this stage.
7. Command sent to go to Idle mode—Unsuccessful Execution with error code of 135 issued by ICU.
8. Filter Wheel moved to Datum—HK checked to validate.
9. Command sent to go to Idle mode—Unsuccessful Execution with error code of 135 issued by ICU.
10. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and F/W at requested position packet issued.
11. Command sent to go to Idle mode—command accepted. HK showed instrument in Idle mode.

Results

All Errors and acceptance messages issued as expected as described above.

Codes affected

modeman.adb version 1.11

Performed by: HEH at MSSL

11.5 Test report for ECR 88 part 3

Purpose of tests

To check that it is not possible ramp up the high voltages unless the filter wheel is in the blocked position.

Test Location

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

Unsuccessful Execution with error code of 135—Filter Wheel not at blocked—should be issued upon any attempt to ramp up the high voltages when filter wheel is not at blocked.

Tests performed

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Filter Wheel moved to Datum—HK checked to validate.
8. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and then F/W at requested position packet issued.
9. Command sent to go to Idle mode—command accepted.
10. Filter wheel moved to Grism 1 position (Filter Number 10)—HK checked to validate.
11. Sent commands to ramp mcp23 to 100 V—received expected unsuccessful execution packet with error code of 135 (Filter Wheel not at blocked).
12. Filter wheel moved to blocked position (Filter Number 0)—HK checked to validate.
13. Sent commands to ramp mcp23 to 100 V—HK confirmed that mcp23 ramped up to expected value.

Results

All Errors and acceptance messages issued as expected as described above.

Codes affected

detanalog.adb version 1.27

Performed by: HEH at MSSL

11.6 Test report for ECR 89

Purpose of tests

To check that the ICU automatically safes the instrument in the event of loss of satellite polling of the telemetry queue—leading to a telemetry queue full condition—within 1 minute.

Test Location

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

The instrument should be in safe at the end of the test sequence.

Tests performed

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Filter Wheel moved to Datum—HK checked to validate.
8. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and F/W at requested position packet issued.
9. Command sent to go to Idle mode—command accepted.
10. Simulated loss of spacecraft by stopping vxworks for 1 min (this provides the mechanism that polls the telemetry queue).
11. Restarted and reset VxWorks
12. Monitoring of HK indicated that the instrument was in safe , the filter wheel blocked and the HV was at zero.

Results

All messages issued as expected. Instrument was in safe at end of above sequence.

Codes affected

detanalog.adb version 1.27

Performed by: HEH at MSSL

11.7 Test report for NCR 167

Purpose of tests

To check that tracking would work with images taken with the magnifier

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Tests performed

Images were taken with the magnifier in the field of view.

Results

Tracking did not work with the magnifier in the field of view. The DPU generate a large number A5B2 (GADE_RANGE_ERROR) and A5AD (GADE_RSIAL_ERROR) exceptions which caused problems with the buffering of the messages, resulting in exceptions being seen after the next filter had been placed in the field of view.

Performed by: JPDM at MSSL

11.8 Test report for NCR 183

Purpose of tests

To check that tracking was turned off when there are no good guide stars

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Tests performed

Images will no good guide stars were used e.g. UV filter images.

Results

With no good guide stars tracking was turned off correctly (as seen by the housekeeping) and the PSF of the stars seen in the images was as expected.

Performed by: JPDM at MSSL

11.9 Test report for NCR 185

Purpose of tests

To check that the offset variable in the first science or engineering packet is initialised to zero.

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Expected results

Offset variable in first science or engineering packey should be set to zero when first starting operational mode.

Tests performed

No tests could be performed at MSSL as this effect is not reproducable at MSSL on our test kit. We await reports from ESA in flight.

Codes affected

packet.ads version 1.20

11.10 Test report for NCR 186

Purpose of tests

To check the fast mode data for an internal inconsistency manifested as more slices sampled than commanded in tracking frame.

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Tests performed

Fast mode data was obtained as part of a science exposure

Results

The effect is still present but was only seen in 15 out of 263 exposures.

Performed by: JPDM at MSSL

11.11 Test report for NCR 187

Purpose of tests

To validate correct dumping of DPU code.

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Expected results

Dump correct.

Tests performed

Dump 0x2990 DPU words starting at location 0xe50000 (MID 0x25)

Results

Start addresses for each block now correct.

Codes affected

memdpu.adb version 1.2

Performed by: HEH at MSSL

11.12 Test report for NCR 188

Purpose of tests

To validate correct dumping of DPU code.

Test Location

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Expected results

Dump present and correct.

Tests performed

Dump 1 DPU local word starting at location 0x5aee (MID 0x13)

Results

Dump produced and contains expected result.

Codes affected

memdpu.adb version 1.2

Performed by: HEH at MSSL

11.13 Test report for NCR 191

Purpose of tests

To check that variable SYNCHRONISING in time_man.adb is correctly initialised to zero.

Test Location.

MSSL

Test environments

Linux Telescope Simulator
FS DEM

Expected results

H5330 in HK should be set to zero when first starting operational mode.

Tests performed

No tests could be performed at MSSL as this effect is not reproducable at MSSL on our test kit. We await reports from ESA on results on their simulator.

Codes affected

time_man.adb version 1.18

11.14 Test report for NCR 192

Purpose of tests

To check that the ICU automatically adjusts the focus heater settings as a function of filter wheel in use.

Test Location.

MSSL

Test environments

QM Optics and BPE FS DEM

Expected results

From the HK, the heater settings for HTR3 and HTR4 should be ON and OFF respectively for all filters except magnifier, when they should be OFF and ON.

Tests performed.

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode—HTR3 and HTR4 are shown to have switched to the default configuration of ON and OFF
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Filter Wheel moved to Datum—HK checked to validate.
8. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate.
9. Command sent to go to Idle mode—command accepted. HK showed instrument in idle.
10. Sent commands to move filter wheel to magnifier (position 2). From HK, HTR3 and HTR4 changed to OFF and ON respectively and remained so for at least 100 secs.
11. Sent commands to move filter wheel to blocked (position 0). From HK, HTR3 and HTR4 changed to ON and OFF respectively and remained so for at least 100 secs.
12. a further check was performed to confirm that the 60 data locations starting at 23a4 hex using a 'peek' facility contained the expected values of heater settings as described in the User Manual

Results

All messages issued as expected. Heaters were in expected status.

Codes affected

mechanism.adb version 1.27 heater.adb version 1.14

Performed by: HEH at MSSL

11.15 Test Report for NCR 193

Problem

The checking of memory access for writing single small word integer would have generated a hard-coded number 0xa555. The code should report with the symbolically defined name DA_GADE_WSI. Since this logic path is rarely passed through, the problem is only found accidentally through inspection.

Action

Implement the correction

Test

1. Write special code to generate this logic path.
2. Load and execute the special DPU codes.
3. Confirm the correct generation of the error message.

Results

Exception message is correctly generated.

Affected codes

include/global_access.c: v. 1.16.

Performed by: Cheng Ho

11.16 Test report for NCR194

Purpose of tests

To check that the ICU automatically always safes the instrument in the event of the DPU sending out data.

Test Location.

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

The instrument should be in safe at the end of the test sequence.

Tests performed.

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Filter Wheel moved to Datum—HK checked to validate.
8. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and F/W at requested position packet issued.
9. Command sent to go to Idle mode—command accepted.
10. Sent commands to ramp mcp23 to 100 V—HK confirmed that mcp23 ramped up to expected value.
11. Filter wheel moved to Grism 2 position (Filter Number 6)—HK checked to validate.
12. Issued 'go to safe' command.
13. Immediately issued a series of DPU command with a code of A400 hex. This is in the valid TID range for the DPU and so is forwarded by the ICU to the DPU. However, it is not a valid DPU command and leads to the issuing of a series of 'Bad Command' error messages.
14. The above 'bad command' messages cause an expected 'Loss of filter wheel position' major anomaly report message (code 60 hex) due to the activity on the SSI.

15. The expected major anomaly report followed—Automatic Safe Transition, code 63 hex—was issued after about 5 secs .
16. Monitoring of HK indicated that the instrument was in safe , the filter wheel blocked and the HV was at zero.

Results

All messages issued as expected. Instrument was in safe at end of above sequence.

Codes affected

mechanism.adb version 1.27

Performed by: HEH at MSSL

11.17 Test report for NCR 195

Purpose of tests

To validate that a 'F/W not datumed' is now correctly sent as an Unsuccessful Command Execution.

Test Location.

MSSL

Test environments

QM Optics and BPE
FS DEM

Expected results

'F/W not datumed' sent as an Unsuccessful Command Execution.

Tests performed.

1. ICU Reset
2. ICU Code loaded
3. Go to Safe Mode
4. DPU code loaded
5. DPU 'clean slate' procedure run—DPU and ICU now in normal operational state.
6. HK monitored to confirm that the filter wheel position is unknown—as expected at this stage.
7. Command sent to go to Idle mode—Unsuccessful Execution with error code of 135 issued by ICU.
8. Filter Wheel moved to Datum—HK checked to validate.
9. Filter wheel moved to absolute position 1200 (Blocked)—HK checked to validate and F/W at requested position packet issued.
10. Command sent to go to Idle mode—command accepted. HK showed instrument in Idle mode.
11. Command sent to go toSafe—this sequence generates a 'DPU_INIT' command at the end.
12. Before the expected DA_END_DPU_INIT was emitted, sent commands to go to filter position1. Thus the alert from the DPU came out whilst the f/w was still moving and caused an expected 'Not at requested position' condition due to activity on the SSI.
13. An attempt was then made to move to filter 11 (tc_fw_filter 11 then tc_fw_move). A 'F/W not datumed' message was issued and was correctly flagged as a major anomaly.

Codes affected

mechanism.adb version 1.25

11.18 Test report for NCR 196

Purpose of tests.

To validate the code changes made for OM-MSSL-NCR 196.

Test Location.

MSSL

Test environment.

ICU QM
DPU breadboard

Expected results

Sending a load hv ramp parameters command whilst the previous high voltage is being ramped will be rejected and an unsuccessful command execution packet (3,4) with the error code of 130 will be issued.

Tests performed

1. ICU is reset to Basic mode.
2. Modified operational code loaded and switched to safe mode.
3. The ICU is commanded into idle mode (mode 2).
4. mcp2,3 ramped to 1500 V.
5. mcp1 ramped to 500 V.
6. mcp1 ramped to 0 V. While the voltage is being ramped down a load task parameter command was sent to ramp mcp2,3 to 0 V. A tc execution failure packet (3,4) was received with error code 130 (Command too soon).
7. mcp1 reached 0 V.
8. A start hv ramp task command was sent.
9. Start hv ramp command rejected with a tc execution fail (3,4) with error code 132 (Parameters not loaded).
10. mcp1 commanded back to 500 V.
11. While mcp1 is ramping the load task parameters command is resent. A tc execution failure packet (3,4) with error code 130 (Command too soon) was received. This command was sent again with the same outcome.
12. mcp1 reached 500 V.
13. mcp1 ramped down to 0 V.

14. A start hv ramp task command sent. This is rejected with a tc execution failure packet (3,4) with errror code 132 (Parameters not loaded).
15. mcp2,3 commanded to ramp down to 0 V.
16. During the ramp the load hv ramp task command was sent three times. Each time the command was rejected with a tc execution failure (3,4) with the error code of 130 (Command too soon).
17. mcp2,3 reached 0 V and the hv was disabled.

Results

The ICU software displayed the expected behaviour.

Performed by: M. C. R. Whillock

11.19 Test Report NCR 197

Problem

It has been observed that ICU operation appears abnormal when setting up the exposure, if the DPU continues to transmit significant amount of data. The key symptom is the DPU does not receive the IC_CHOOSE_GS command. The DPU continues to operate properly. This condition does not appear to have any permanent damage to continuing operation of OM, other than the improper set up of the exposure configuration which leads to loss of science data.

Resolution

This condition has been alleviated during the OM commissioning phase when the constraint was imposed that all data donwlink from the exposure n must be completed prior to the termination of exposure n+1. Thus this condition should not occur under the current operation scenario. If the operation scenario is revised, then this error/issue needs to be recreated/revisited.

Performed by: Cheng Ho

12 Appendix A: VxWorks Scripts

Here are the VxWorks scripts used for software testing in the UK and USA. Frequently used procedures have scripts. Other procedures are followed from ML/0009.

12.1 acquire

```
#################################################################
#
#   Set up some numbers first
#
#################################################################

date
frame_time = 15
bpe_bin = 0
filter = 1
#exp_no = 0xd40001
#copy "/home/xmmom/sim_data/ref_stars.cfg","ref_stars.cfg"

############################################

tc_det_acq_mode 0

# load det acq 0 configuration
< load_table_24
# Jon delay
taskDelay(10*60)

tc_fw_filter 1
tc_fw_move
taskDelay(20*60)

tc_set_bpe bpe_bin
tc_set_exp_no exp_no

tc_det_enbl_frame_tag 1
tc_det_event_threshold 15

# load reference stars
< load_table_25

```

```
# ref frame exp
tc_set_frame_time frame_time*1024

tc_send_command IC_INIT_EXP
taskDelay(3*60)

# change to science mode
#tc_mode 3
# start the detector integration
tc_det_start_int

tc_send_command IC_ACQUIRE_FLD
taskDelay(frame_time*60)
tc_det_stop_int
# should check this
taskDelay(60*60)
```

12.2 cgs

```

date
tc_fw_filter filter
tc_fw_move
taskDelay(20*60)
tc_det_acq_mode 0

# load acq 0 mode
< load_table_24
# Jon delay
taskDelay(20*60)

tc_set_exp_no exp_no
tc_send_command IC_INIT_EXP
taskDelay(3*60)

tc_det_enbl_frame_tag 1
tc_det_event_threshold 15

############
tc_set_frame_time frame_time*1024
# tc_prog_mem_wind "mmw.cfg"
< load_table_28
# tc_prog_sci_wind "scw.cfg"
< load_table_29
tc_set_exposure_time exposure_time
tc_set_bpe bpe_bin
tc_det_start_int
tc_send_command IC_CHOOSE_GS
taskDelay((frame_time+40+40)*60)
tc_det_stop_int
# Jon delay
#taskDelay(60*60)
```

12.3 exp

```

date
tc_det_acq_mode 2
tc_set_bpe bpe_bin
#
# Put BPE into the right mode, really shouldn't be here
#
tc_det_enbl_frame_tag 1
tc_det_event_threshold 15
#
tc_det_start_int
# taskDelay 2*60
tc_send_command IC_TRACK_GS
taskDelay((frame_time*(exposure_time+1)+10)*60)
tc_set_trk 1

```

12.4 eng3

```
date
open_packet_archive("/data/xmmom/archive/d40003")
frame_time=300
tc_mode 4

tc_init_dpu
taskDelay(60*25)
# expect Dave from the Grave

tc_fw_filter 0
tc_fw_move
taskDelay(20*60)
tc_det_flood_led_current 4
tc_set_frame_time frame_time*1024
tc_set_exp_no 0xd40003
tc_send_command IC_INIT_EXP
# tm_wait_for_alert DA_EOT_INIT_EXP
taskDelay(3*60)

det_reset_wind
# full size
#det_wind 64, 15, 256, 256
#inner part
det_wind 64+32, 15+32, 256-64, 256-64
tc_det_load_windows 1
taskDelay(60*60)

#turn on eng7 if necessary - probably not for post perigee procedure
#tc_enbl_verbose 4,1
tc_det_enbl_frame_tag 0
tc_det_event_threshold 15

tc_det_acq_mode 4

# start sending events from mic
tc_det_start_int

tc_enbl_eng 1, 3

# wait for DA_ENDOF_EXP DA_COMPLETE_EXP all data
taskDelay(frame_time*60)
# the following delay is for 4,1
#taskDelay(500*60)
```

```
taskDelay(380*60)

close_packet_archive
tc_det_flood_led_current 0

tc_mode 2
```

12.5 eng4

```
date
open_packet_archive("/data/xmmom/archive/d40004")
frame_time=1500
tc_mode 4

tc_init_dpu
taskDelay(60*50)
# expect Dave from the Grave

tc_set_frame_time frame_time*1024
tc_set_exp_no 0xd40004
tc_send_command IC_INIT_EXP
# tm_wait_for_alert DA_EOT_INIT_EXP
taskDelay(3*60)

det_reset_wind
det_wind 64, 15, 256, 256
tc_det_load_windows 1
taskDelay(60*60)

# Jon delay
taskDelay(20*60)

tc_det_enbl_frame_tag 0
tc_det_event_threshold 15
tc_det_acq_mode 3

# start sending events from mic
tc_det_start_int

tc_enbl_eng 1, 4

# wait for DA_ENDOF_EXP
taskDelay(frame_time*60)
#tm_wait_for_alert DA_COMPLETE_EXP
taskDelay(4800*60)
taskDelay(1000*60)
```

12.6 eng5

```
date
open_packet_archive("/data/xmmom/archive/d40005")
# was 600
frame_time=4000
tc_mode 4

tc_init_dpu
taskDelay(60*50)
# expect Dave from the Grave

tc_fw_filter 0
tc_fw_move
taskDelay(20*60)
tc_det_flood_led_current 4
tc_set_frame_time frame_time*1024
tc_set_exp_no 0xd40005
tc_send_command IC_INIT_EXP
# tm_wait_for_alert DA_EOT_INIT_EXP
taskDelay(3*60)

det_reset_wind
det_wind 64, 15, 256, 256
tc_det_load_windows 1
taskDelay(60*60)

tc_det_enbl_frame_tag 0
tc_det_event_threshold 15
tc_det_acq_mode 3

# start sending events from mic
tc_det_start_int

tc_enbl_eng 1, 5

# wait for DA_ENDOF_EXP
taskDelay(frame_time*60)
taskDelay(130*60)
#tm_wait_for_alert DA_COMPLETE_EXP
taskDelay(20*60)
# wait for data
taskDelay(20*60)

close_packet_archive
```

```
tc_det_flood_led_current 0

tc_mode 2
```

12.7 eng6

```
date
open_packet_archive("/data/xmmom/archive/d40006")
frame_time=20
tc_mode 4

tc_init_dpu
taskDelay(60*25)
# expect Dave from the Grave

tc_fw_filter 0
tc_fw_move
taskDelay(20*60)
tc_det_flood_led_current 4

tc_set_frame_time frame_time*1024
tc_set_exp_no 0xd40006
tc_send_command IC_INIT_EXP
# tm_wait_for_alert DA_EOT_INIT_EXP
taskDelay(3*60)

det_reset_wind
det_wind 64, 15, 256, 256
tc_det_load_windows 1
taskDelay(60*60)

tc_det_enbl_frame_tag 0
tc_det_event_threshold 12
tc_det_acq_mode 6

# start sending events from mic
tc_det_start_int

tc_enbl_eng 1, 6

# wait (exposure time) for DA_ENDOF_EXP
taskDelay(frame_time*60)
#tm_wait_for_alert DA_COMPLETE_EXP
taskDelay(20*60)
# wait for end of data
taskDelay(20*60)

close_packet_archive

```

```
tc_det_flood_led_current 0

tc_mode 2
```

12.8 flatfield

```

date
open_packet_archive("/data/xmmom/archive/d40018")
#####################
# Common parameters for all 4 FF
#
frame_time = 25
exposure_time = 20
bpe_bin = 1
track = 0
filter = 0
led = 4
copy "/home/xmmom/sim_data/e40018/mmw.cfg","mmw.cfg"
#####################
tc_fw_filter 0
tc_fw_move
taskDelay(20*60)
tc_set_bpe bpe_bin
tc_mode 2
tc_mode 4
tc_det_flood_led_current led
tc_mode 2
tc_mode 3
######################
# Specific parameters for FF
#
exp_no = 0xd40008
copy "/home/xmmom/sim_data/e40018/scw.cfg","scw.cfg"
######################
# could be <cgs_wo_fw_move to save some time
#
tc_set_trk track
<cgs
<exp
######################
# Specific parameters for FF
exp_no = 0xd40009
copy "/home/xmmom/sim_data/e40019/scw.cfg","scw.cfg"
######################
# could be <cgs_wo_fw_move to save some time
#
tc_set_trk track
<cgs
```

```
<exp
######################
# Specific parameters for FF
exp_no = 0xd4000a
copy "/home/xmmom/sim_data/e4001a/scw.cfg","scw.cfg"
######################
# could be <cgs_wo_fw_move to save some time
#
tc_set_trk track
<cgs
<exp
######################
# Specific parameters for FF
exp_no = 0xd4000b
copy "/home/xmmom/sim_data/e4001b/scw.cfg","scw.cfg"
######################
# could be <cgs_wo_fw_move to save some time
#
tc_set_trk track
<cgs
<exp
######################
tc_set_bpe 0
tc_mode 2
tc_mode 4
tc_det_flood_led_current 0
tc_mode 2
tc_mode 3

#########################################################################
#########################################################################
# vvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvvv
# remember to flush and close_packet_archive ############################
# ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
#########################################################################
#########################################################################
```

12.9 reset_icu

```
date
tc_fw_to_datum
tc_fw_move
taskDelay(25*60)
tc_fw_abs_steps 1200
tc_fw_move
taskDelay(20*60)
tc_enable_sid 0xff
tc_mode 2
```

12.10 tc_clean_slate

```

date
#
#  Reset the ICU to the operational mode
#

rate 8

open_packet_archive "/data/xmmom/archive/d80ini"

set_dump_tm 0

####################################################
#
# This script brings up the DPU in a clean slate
#
####################################################

# clear all GSE semaphores

tm_clear_sem

#
#  First reset the DPU
#
tc_reset_dsp 0
taskDelay (60*12)

#
# Next reload the DPUOS
#
tc_load_dpuos
taskDelay (60*10)

# Turn on all color processors
tc_enbl_dsp red,1
taskDelay (60*10)

tc_enbl_dsp blue1,1
taskDelay (60*10)

tc_enbl_dsp blue2,1
taskDelay (60*10)
```

```

# Select blue2 as the klingon
tc_sel_klingon 1

# synchronize the clock bewteen ICU and DPU
tc_synch_clk_auto

#wait for it to happen
taskDelay(60*2)

#################################################################
#
# Initialize DPU
#
#################################################################
tc_init_dpu
taskDelay(60*45)
# expect Dave from the Grave

# DA_TRK enabled by code - not selectable
#tc_report_tracking 1
# DP_TRH enabled already
#tc_enbl_verbose 0,1
# turn on DD_REF verbosity
tc_enbl_verbose 3,1

# remove this later. special patch to debug Linux/Sim
#tc_load_local_ram 0x5c60,0x30

close_packet_archive
```

12.11 load_icu

```
rate 100
set_dump_tc 0
set_dump_tm 0
packet_load < /home/pjs1/icu/fm/oper/icu.hex
#set_dump_tc 1
#set_dump_tm 1
rate 8
```

12.12 load_dpu

```
rate 100
set_dump_tc 0
set_dump_tm 0
tc_reset_dsp
taskDelay(60*10)
tc_packet_load 0 < /home/xmmom/dpu/development/eeprom/p0.cmd.0
tc_packet_load 5 < /home/xmmom/dpu/development/eeprom/p5.cmd.0
tc_packet_load 7 < /home/xmmom/dpu/development/eeprom/p7.cmd.0
tc_packet_load 3 < /home/xmmom/dpu/development/eeprom/blue_p3.cmd.0
#set_dump_tc 0
#set_dump_tm 0
#taskDelay(60*12)
tc_load_dpuos
taskDelay(60*6)
rate 8
```

12.13 load_table_24

```
det_reset_wind
det_wind 64,15,128,128
det_wind 64,143,128,128
det_wind 192,15,128,128
det_wind 192,143,128,128
tc_det_load_windows 4
taskDelay(30*60)
```

12.14 load_table_25

```
tc_prog_ref_stars "ref_stars.cfg"
```

12.15 load_table_28

```
tc_prog_ref_stars "ref_stars.cfg"
```

12.16 load_table_29

1 `tc_prog_sci_wind "scw.cfg"`

12.17 hvonr

```

date
tc_det_load_hv_ramp_params 3,100,25,0
tc_det_start_hv_ramp
taskDelay(10 * 60)

tc_det_load_hv_ramp_params 3,1400,25,0
tc_det_start_hv_ramp
taskDelay(90 * 60)

tc_det_load_hv_ramp_params 2,500,25,0
tc_det_start_hv_ramp
taskDelay(40 * 60)

# don't need
#tc_det_load_hv_ramp_params 1,2,25,0
#tc_det_start_hv_ramp
#taskDelay(8 * 60)

tc_det_load_hv_ramp_params 1,390,25,0
tc_det_start_hv_ramp
taskDelay(30 * 60)

tc_det_load_hv_ramp_params 3,1830,25,0
tc_det_start_hv_ramp
taskDelay(30 * 60)

tc_det_load_hv_ramp_params 2,650,25,0
tc_det_start_hv_ramp
taskDelay(10 * 60)
```

12.18 hvoff

```

date
tc_det_load_hv_ramp_params 1,0,25,0
tc_det_start_hv_ramp
taskDelay(30*60)

tc_det_load_hv_ramp_params 2,0,25,0
tc_det_start_hv_ramp
taskDelay(40*60)

tc_det_load_hv_ramp_params 3,0,25,0
tc_det_start_hv_ramp
taskDelay(100*60)
```

12.19 flush

```
date
tc_send_command IC_FLUSH_CMPRS
```

12.20 reset

```
date
reset
packet_msg 0
taskDelay(20*60)
packet_msg 1
```