# Period 36
# AiC Report to the NOT Council and STC

## $48^{th}$ STC meeting, April 28, 2008
## &
## $53^{rd}$ Council meeting, April 29, 2007

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# Contents

# 1 Introduction

This report covers the operations of the Nordic Optical Telescope for period 36: 2007-10-01 to 2008-04-01.

# 2 Down Time

The down time statistics are based on individual fault reports. In Table 1 I give the general down time statistics for period 36. A total of 74 fault reports were submitted, with an average time lost of 14 min per fault, for a total down time of 0.8% (1.1% on scheduled observing nights). Of these, 47 reported no time lost, 24 reported < 2 hrs lost, and 3 reported 2 or more hrs lost.

Table 1: Technical down time statistic period 36: 2007-10-01 to 2008-04-01

| Night included | Time lost | Nights | Percentage[a] | Last semester | Last winter |
|---|---|---|---|---|---|
| All nights | 1030 min | 183 | 0.8% | 1.4% | 0.7% |
| Scheduled observing nights[b] | 975 min | 127.5 | 1.1% | 1.8% | 0.8% |
| Technical nights | 55 min | 20.5 | 0.4% | 1.1% | 0.3% |
| Service nights[c] | 260 min | 35 | 1.1% | 2.6% | 0.6% |
| Visitor instruments | 0 min | 14 | 0.0% | 0.1% | 0.0% |

[a] Taking the average length of time within nautical twilight. Exact numbers for each night are used when looking at 'All nights'

[b] Excluding technical nights and visitor instruments

f [c] Excluding service nights with SOFIN

This compares to a down time of 1.4% (1.8% on scheduled observing nights) in period 35 and 0.7% over all nights (0.8% on scheduled observing nights) in period 34. Of the 118 fault report in period 35, 80 reported no time lost, 34 reported < 2 hrs lost, and 4 reported 2 or more hrs lost. Of the 117 fault report in period 34, 82 reported no time lost, 35 reported < 2 hr lost, and none reported 2 or more hrs lost.

Apart from the continuously low down time, the only thing to notice is the relatively low number of fault reports during the last semester.

## 2.1 Weather

For period 36 a total of 736hr 32min was lost due to bad weather which corresponds to 36.0% of all the dark time as compared to 11.1% in period 35 and 36.9% in period 34. The total amount of clear dark time was 1311hr in period 36, as compared to 1443hr in period 35 and 1285hr in period 34.

## 2.2 General overview

In Table 2 the number of faults and total time lost as a function of the system and kind of fault is presented together with the overall numbers for the previous two period (34 and 35).

Table 2: Down-time statistics for period 36[a]

| Syst/Type | Soft | | Elec | | Optics | | Mech | | Others | | Total | | P34/P35 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Telescope | 7 | 00:50 | 4 | 00:05 | 0 | | 1 | 00:00 | 2 | 01:15 | 14 | 02:10 | 29/29 | 03:10/07:45 |
| Building | 0 | | 1 | 00:10 | 0 | | 1 | 00:00 | 2 | 00:00 | 4 | 00:10 | 5/3 | 00:00/00:00 |
| Computers | 4 | 00:15 | 4 | 00:00 | 0 | | 0 | | 3 | 00:00 | 11 | 00:15 | 18/13 | 03:55/00:00 |
| ALFOSC | 18 | 04:55 | 9 | 07:05 | 1 | 00:00 | 1 | 00:00 | 1 | 00:00 | 30 | 12:00 | 24/25 | 03:40/06:50 |
| MOSCA | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | 00:00 | 5/4 | 01:00/00:05 |
| NOTCam | 2 | 00:05 | 0 | | 0 | | 0 | | 0 | | 2 | 00:05 | 9/15 | 00:10/00:50 |
| StanCam | 2 | 00:15 | 0 | | 0 | | 0 | | 0 | | 2 | 00:15 | 7/8 | 00:45/00:30 |
| FIES | 5 | 02:15 | 1 | 00:00 | 0 | | 0 | | 0 | | 6 | 02:15 | 4/14 | 01:25/05:45 |
| Others | 0 | | 3 | 00:00 | 0 | | 1 | 00:00 | 1 | 00:00 | 5 | 00:00 | 16/7 | 00:05/00:15 |
| Total | 38 | 08:35 | 22 | 07:20 | 1 | 00:00 | 4 | 00:00 | 9 | 01:15 | 74 | 17:10 | 117/118 | 14:10/22:00 |
| P34 | 69 | 10:10 | 18 | 01:15 | 2 | 00:00 | 10 | 00:30 | 18 | 02:15 | 117 | 14:10 | | |
| P35 | 59 | 08:35 | 26 | 10:00 | 2 | 02:00 | 14 | 00:05 | 17 | 01:20 | 118 | 22:00 | | |

[a]For each system-type category the total number of faults and total time lost are given

## 2.3 Main problems

Below are listed those faults for which 2 or more hours were lost.

- **2007-12-28: ALFOSC calibration lamp**: 2 hr 00 m

  The problem was one of the ALFOSC calibration lamps that had remained switched-on while observing with FIES. This did not affect the resulting spectra with FIES as the lamp shines away for the fiber entrance, but it seriously affected the target acquisition which is done with StanCam which is positioned on the opposite side. The software has been changed to make sure that the lamps are switched-off under all normal circumstances.

- **2008-02-(4/2-16/3): FASU shutter**: 5 hr 35 m

  On a few occasions with large intervals in between the shutter of the Filter and Shutter Unit which contains two filter wheels and is mounted between the telescope and either ALFOSC or MOSCA would closed by itself. Various solutions where tried, where the most likely cause was believe to be a loss of power to the controller of the shutter and the wiring was checked and the power supply was replaced. Unfortunately, the error would only occur after many days or weeks while thorough testing did not show a problem. The last solution that was tried was to replace the converted which regulates the incoming voltage to the correct value.

Since this unit was replaced more than a month ago no more problems have been reported and the problem has likely been solved.

Apart from the first time the problem occurred, relatively little time was lost on subsequent occasions with the exception of one case where the observer tried to solve the problem himself. This actually caused more problems which is included here in the total down time.

- **2008-03-21: Fiber offset**: 2 hr 00 m

  During observations with FIES continuous problems were encountered centering targets on the fiber. This was mainly due to errors by the observers not following the precise and detailed instructions provided. However, the way the system works is not very transparent and also allows the errors to be made without any warning and we are working on making the system more fail proof.

# 3 Instrument use

Table 3 lists the number of scheduled observing nights and technical nights for each instrument. This covers all nights, including CAT, CCI and guaranteed time. In this table I have also included the number of observing runs, and the number of nights per observing run for each instrument.

Table 3: Instrument use

| Instrument | No. of nights | | No. of runs | Nights/run |
|---|---|---|---|---|
| | Scheduled | Technical | | |
| ALFOSC | 80.5 | 10.5 | 26[a] | 2.3 |
| NOTCam | 5 | 1 | 2[b] | 2.0 |
| MOSCA | 28 | – | 8 | 3.5 |
| FIES | 35 | 1 | 6 | 3.5 |
| SOFIN | 6 | 1 | 1 | 6.0 |
| TurPol | 3 | 1 | 1 | 3.0 |
| IACub | 1 | – | 1 | 1.0 |
| PolCor2 | 4 | 2[c] | 1 | 4.0 |
| FastCam | – | 4[c] | 1 | – |

[a] Excluding 20 service nights [b] Excluding 1 service nights
[c] Used to conduct observations for small programs in service mode

# 4 Comments recorded in End-Of-Night & End-Of-Run reports

As before, most comments written in the reports during period 36 were very positive, especially about the support from the staff. One practical complaint was about the telescope not being optimal for the observations of solar system objects. Although this was partly caused by a misunderstanding of the system and the exceptionally high angular velocity of the object that was observed, it appears to be true that using modified tracking rates without using the autoguider gives much worse results than one would expect. This is being investigated.

On the observing side, there were some comments on the documentation being rather variable in the amount of detail that is being provided, but it was also noted that the documentation is rather complete. There were also some comments about the FIES target acquisition being complicated, the ALFOSC spectroscopic target acquisition being complicated under certain specific circumstances and the ToO instructions for observations with StanCam not being up-to-date for use with the new sequencer. All these issues have been addressed.

On the safety side, there was one comment on the instruction what to do in case of ice forming at the telescope. In fact, as the conditions can be very different there are no general instructions and the specific instruction is to follow the instructions given by the staff in each case. This is what actually happened in this case, but the observer apparently felt that written instruction were more reliable than following orders from the staff. It was also noted that for safety reasons it would be good to have the side ports equipped with motors. This is not a trivial thing to change, but we might consider it in relation to remote observing without anybody present at the telescope.

# 5 Operations

## 5.1 Additional services

### 5.1.1 Educational set-up

To improve the sound connection between the telescope and the 'class room' set-up in the Service Building the system has been changed to unidirectional broadcasting of the sound from the control room to the service building and a 'chat-room' system (microphone plus head phone) for direct communication to avoid feedback problems when using an open bidirectional system.

Included in the facilities for courses we now provide a full set of 12 laptops for the students. These are offered with a common 'standard' installation on a Linux platform. In principle this includes all basic astronomy reduction and analysis packages, but the specific installation can be adapted for each course.

A lot of experience in organizing and hosting observing courses have been gained over the past years, while also the facilities and infrastructure at the observatory has been developed and optimized for educational use. A document was prepared that gives an overview of what is offered to groups that want to use the NOT for an observational course and provide general guide lines which describes the various steps in the preparation, including specific suggestions for the organizers of such a course.

### 5.1.2 Service observing

A total of 35 nights of service observing were done, excluding the 6 SOFIN nights done in service mode by Dr. Ilya Ilyin, and the 4 nights of technical time with FastCam and the 2 night of technical time with PolCor2 where, respectively, Dr. Rafael Rebolo (IAC) and Dr. Gøran Olofsson (University of Stockholm) executed various small observing programs in service mode. What showed a large increase during the past semester was the number of observations that were done by the staff for the ToO programs during technical nights. The Nordic service nights consisted of various more or less isolated observing nights spread throughout the semester.

### 5.1.3 'Fast-Track' Service Program

For period 34 there were 8 proposal, of which there were 6 'grade 1' proposals and 2 'grade 2' proposals. Of the 'grade 1' proposals 4 are completed, one is completed for 2/3 and one is completed for 1/2. Both 'grade 2' proposals were completed.

For period 35 there were 8 proposal, of which there were 6 'grade 1' proposals and 2 'grade 2' proposals. Of the 'grade 1' proposals, 5 were completed and one is completed for 1/2. Of the 'grade 2' proposals, 1 was completed.

For period 36 there were 19 proposals. Of these there were 10 'grade 1' proposals, 6 'grade 2' proposal, and 3 'grade 3' proposal. Of the 'grade 1' proposals, 4 were completed and 2 were completed 1/2. Of the 'grade 2' proposals, 1 was completed. Of the 'grade 3' proposals, 1 was completed and 1 was completed for 1/2.

For period 37 up till now 1 proposal has been submitted. It received 'grade 1' and the proposal has been completed 1/2.

With the start of period 37 the fast-track service observing system has been expanded to included the option to indicate specific dates for the observations. This can be used for time-critical observations (e.g., of eclipses), or for observations which need to be done at certain intervals, etc.

### 5.1.4 Target-of-opportunity observations

In principle, the information needed to keep track of how much time is being used by the different ToO and monitoring programs should be provided in the end-of-night reports, but often the information is incompletely or unclear. To improve this and make it easier to keep track of the different ToO programs the end-of-night forms were changed. Specifically moving away from a free format for the ToO information to a fixed format with pre-defined (e.g., proposal name) options.

## 5.2 Observing conditions

### 5.2.1 Weather station

The new Vaisala weather station is mounted on the same mast as the existing one. Data from the new station is now also saved in data base for comparison with old station data. There were some problems with the wind measurements of the new station, readings occasionally dropping to zero, and a fix has been incorporated in the reading program.

There were some discussions about the validity of the humidity measurements and the rules for closing the telescope when comparing the measurements to those from other telescopes and those from the Vaisala station. One issue is that the humidity meter of the Vaisala station has not been calibrated yet while we also do not know if, and in what way the meters at other telescopes have been calibrated. In general, for the rules for closing it is primarily important that they are well defined. The precise behavior of the meter is a different issue. As there is still the question if at times the humidity is lower than indicated (especially important when the temperature is below zero) and a proper hand held humidity meter was purchased.

The communication to the weather station has been changed from a copper 'current-loop' serial link to a fibre optic Ethernet line. This new line accommodates both the old and new weather stations as well as a web cam. The change also removes a frequent problem of lightning strikes on the serial link which sometimes destroyed the transmitter and receiver devices.

### 5.2.2 Weather pages

The web pages showing the weather conditions at the NOT have been upgraded and now include real time data from the dust meter and from the seeing monitor at the ING, and various direct links to observing related information. There is also an option to get an overview of the weather conditions at the different telescopes at the observatory.

## 5.3 Building

### 5.3.1 Drive System

We have purchased the components for the new drive system of the telescope building. This includes four motors, amplifiers, servo control electronics and cabling. The system needs to be assembled and the electronics needs to be programmed. As part of the purchase, an engineer from Siemens will visit to provide technical advise. Currently, the precise details of the installation and the required modifications to our system are being discussed and a work plan and schedule is being made. Given the delay in the installation of the amplifiers for the telescope drives (see below) the change of the drive system is now foreseen for the autumn.

### 5.3.2 Observing floor

With the return of Peter Brandt extensive progress has been made with cleaning up and reorganizing the observing floor. This makes work at the telescope easier and allows the remaining items (mostly instruments trolleys) to be positioned better such that they don't effect the airflow when the side ports are open, which potential might affect the imaging quality of the telescope.

### 5.3.3 Clean room

We currently have a small room in the service building which has been set-up as a clean room. This room is intended for work on sensitive parts of the instruments, specifically the detector systems, and it is primarily used for working on NOTCam where the whole instrument is contained with the detector in one vessel. The main problem with the current arrangement is that NOTCam needs to be transported from and to the telescope every time any work needs to be done on it, and this both takes extra time and is dependent on the weather.

To make this easier and more efficient a system was designed that consists of a tent-like structure with a ventilation system with filter which can be dismantled easily. With space becoming available this tent can be set-up on the observing floor next to the telescope. Generating an overpressure in the tent with the filtered air provides a similar environment as the current clean room. In principle the system would be only used during the day time and should not interfere with normal observations. The design also includes a work table which can be sealed off with a cover to protect anything that would remain exposes when the ventilation system is switched-off and/or the tent dismantled.

## 5.4 Telescope

### 5.4.1 Adapter

During the writing of this report a very serious error was encountered with the 'cable twist' which conducts the various communication cables from the devices attached to the rotator to the fixed telescope structure. It was found that the cable which guides this cable twist had broken, likely through wear and tear over the last 18 years since the installation. When this wire is broken a mechanism acts on a switch which activates an interlock and cuts the rotator power and amplifier. However, as in other cases the documentation does not show this limit switch and the TCS does not receive any specific warning, and the only sign on the TCS is that the rotator appears to have switched from remote control to local control, which pointed to a problem with the power supply or the amplifier of the rotator. This seriously complicated identifying the true problem. Also, repairing the cable took relatively long as it required a certain type of cable of sufficient length, and at some moment progress was delayed for many hours because the only cable we could get was $\sim$20cm short.

Although it is impossible to define potential problems of parts in the telescope that are not documented, we plan to make a general review of all the status parameters in the TCS to see if they are well defined and can be properly identified (e.g., the parameter for the status of a specific part is connected to a signal that can be traced to that part). In case this is not clear or ambiguous any error or warning status for this part reported by the TCS should note this to make people aware that the true problem might be hidden.

### 5.4.2 Telescope control system

Also during this semester various minor upgrades were implemented and work is progressing on the documentation and the logging system.

The TCS Display application which provides a small window with basic TCS information (coordinates, telescope status, etc) and can be run from anywhere in the observing system is being expanded to include information from the guide star system (e.g., relative position of the star, total measured intensity) such that the guide process can be monitored. The specific objective is to provide this for the NORDFORSK remote observing school this summer.

The number of status parameters for the telescope that are recorded in the data base has been further expanded. This make them accessible on the data acquisition computer which can be used in observing scripts.

A new option has been implemented that allows to send any command to the TCS from the sequencer as if one where at the TCS terminal itself. These commands can be any available TCS command with a few exceptions like 'power-on', 'open-upper-hatch', etc. for safety reasons. This option is only intended for 'expert' users as there is no build-in communication with the TCS in this option, e.g., the system does not wait to complete the command before continuing with a script. The general idea is that this on the one hand gives full capability to scripting observations while it should also show quickly what are often used commands that would benefit from becoming true sequencer commands.

### 5.4.3 Tracking

During observations of solar system objects some problems where noted with differential tracking. The system works properly when the autoguider is used, including for rather high ($\sim$400 arcsec per hour!) differential tracking rates. However, data taken with the telescope tracking without using the autoguider show very significant distortions and is much poorer than one might expect. The data points to some problem in the way non-sidereal tracking rates are applied. This is currently being investigated.

#### 5.4.4 Autoguider

A system has been implemented that automatically detects guide stars and centers them in the guide box after which guiding is switched on. The current system is not fail proof, but under normal weather conditions it is a useful tool and increase efficiency. To improve the system further, the idea is to 'export' the data to an other computer as the computing power of the TCS computer is relative small. This will allow for a more sophisticated processing of the data which should lead to a more reliable guide star search and detection system. In fact, within the new sequencer system it is actually possible to control the different parts of the telescope and instrument from anywhere in the observing system, and in principle the whole autoguiding process can be managed from outside the TCS computer.

The options to select guide stars have been extended and now includes the possibility to select any of the guide stars provided by the guide star server, and it now also includes the option to select different permitted areas where to look for possible guide stars. In principle the permitted areas can vary depending on which instrument is in use, but one could also, e.g., define a specific (small) area to assure that the telescope can do relatively large offsets (e.g., for 'beam-switching' observations with NOTCam) without the guide star moving beyond the area reachable by the guide probe.

#### 5.4.5 Balancing

With the change in weight distribution on the telescope with the new TCS the balancing of the telescope has changed. For all instruments currently being in use new settings where determined for the movable counterweight.

#### 5.4.6 Amplifiers

The work on incorporating the new alt/az amplifiers for the telescope has taken significantly longer as some redesigning was necessary to make things compatible with the existing motors. Currently we are still waiting for some new parts to arrive, but we expect the installation to be made before the summer.

#### 5.4.7 Mirror cleaning

The latest measurements have shown a significant degradation of the main mirror, but it should be noted that the mirror has not been washed during the past winter months and things are expected to improve somewhat. However, it seems likely that we have to aluminizing the mirrors in the summer of next year.

## 5.5 Observing

### 5.5.1 Observing set-up

One of the main remaining issues is the large amount of windows that are on the display of the data acquisition computer showing the incoming data and the processed data, and the status of the detector(s) and instrument(s). This is especially an issue for FIES as StanCam needs to be operated at the same time for target acquisition. We are working on this in several ways, where the main objective is to better use the available space. Specifically, we are developing a way of displaying observing data (both raw and processed data, e.g., sky subtracted NOTCam data) in a single display with a varying number of sub-windows. Also, the idea is to develop new status displays for the detectors which are smaller and specifically tailored to the available space.

### 5.5.2 Script generator

The observing script generator has been modified to provide sequencer compatible scripts for all commonly available instruments, with the exception of MOSCA which has not been converted for use with the sequencer yet. We are currently in the process of building up a repository of standard observing scripts for use with the sequencer. This will form the basis of a new, more powerful script generator that will take full advantage of our integrated observing system.

## 5.6 ALFOSC

### 5.6.1 Detector

Several upgrades were made to the code on the multi-window fast photometry sequencer board for the detector controller. The objective was to make it fully compatible for use with the normal data acquisition system. However, still some problems have been reported and we need some more extensive comparative tests between the different sequencer boards to define any remaining issues.

A detailed shutter test was made which resulted in a small revision of the shutter-delay correction applied. Several tests have show the remaining error to be less than $\sim$0.005 sec, but future tests should show if the shutter-delay is stable on longer timescales. The tests actually showed that the shutter speed limits any exposure to a minimum of 0.3 sec. Any variation in the shutter timing across the field of view is less than one part in 1000 for the shortest exposure time.

### 5.6.2 Imaging

Recently some problems where reported with the calibration of data on one side of the detector. It is not clear if this is limited to a particular filter, but we are investigating the data and there might be some relation to the change in camera that was made some time ago.

A script is being developed that will automatically take a full set of flat fields in a particular filter. In simple next step would be to combine various such scripts to take all the flat fields for a set of filters. Also, a script is being made that will automatically perform the observations for the photometric zero point monitoring program.

#### 5.6.3 Filters

The filter web pages have been updated and now include a direct link to the filter data base that was recently set-up. The relation between telescope focus and thickness for filters in the convergent beam of the telescope was measured.

As filters with diameters of 75 mm and larger can only be mounted in FASU, we are in the process of making individual holders for all these filters such that they can be permanently mounted in their holder which should reduce the work when changing filters and should also reduce the risk in handling the filters.

For the square 75mm the design of the holder is being changed to protect them better when installing the filters and should reduce any possible light leaks.

#### 5.6.4 Multi-window fast photometry

To improve trouble shooting when the multi-window fast photometry program is used logging of the commands given in the TCPCOM program and of the commands that are send to the detector controller have been implemented.

#### 5.6.5 Spectroscopy

Recently various of the calibration lamps have failed and some extra spares were purchased. Also, a new FeAr lamp was bought which will be tested to see if it provides an alternative for the ThAr lamp (specifically on the required exposures times which are long for the ThAr lamp).

The procedure to measure ALFOSC grism efficiencies have been defined in detail, and the efficiency of the grism re-measured. This and the information on fringing on the web pages will be updated.

The target acquisition process will be further streamlined and a sequencer command will be made such that this process can be started from a script.

#### 5.6.6 Polarimetry

The web pages for polarimetry with ALFOSC have been updated and improved. Sequencer scripts for doing polarimetry have been developed and are fully documented on these webpages.

From test doing linear polarimetry using 4 positions of the half-wave plate it appears that the accuracy seems to be limited to a level of $\sim$0.25%, which might be caused by the two beams following slightly different paths through the optics. One would expect that doing observations using 8 positions of the half-wave plate would provide more accurate results as the different polarization orientations effectively swap paths in the second set of 4 positions. If might even be that the position of the half-wave plate itself effects the result, and observations using 16 positions of the half-wave plate might be needed to provide the most accurate results. This needs to be checked.

### 5.6.7 Documentation

Some rearranging and changes were made to the documentation on the web, mostly related to the introduction of the sequencer. The plan is to modify the general outlook of the ALFOSC web pages to make them more in line with the general 'style' of the web pages as seen on the main NOT web page.

## 5.7 NOTCam

### 5.7.1 Data acquisition

The new Sequencer for NOTCam has been tested and will be offered to visitors on the next NOTCam observing run in May. A new sequencer version of the NOTCam script generator has been made, but needs testing. A number of scripts have already been converted to sequencer type, and a number of scripts still need to be written, also because the sequencer mode allows more scripting. All documentation will be updated to be Sequencer valid before the next visitor run in May.

The NOTCam teloffset command and the TCS autoguider status have been modified in order to avoid that an integration is started before the telescope has come completely at rest and is autoguiding after a dither. Whether more tweaking is needed must be tested in very good seeing. The modification does imply larger overheads when offsets are made.

The overheads related to data acquisition, being overheads to reading the array, storing the data files, and dithering the telescope, have been studied in a large dataset from 2006 to 2008 and a detailed report on the results was made. Surprisingly, the overheads change with time, and it appears to be important to monitor them. The reason why the dither overhead has increased is understood (see above). However, for the readout and storage overheads it is not at all clear what causes the sometimes very large overheads, and why they have become worse with time. Some possibilities have been suggested, but specific extra tests and a dedicated meeting are planned.

### 5.7.2 Imaging

The NOTCam quick look reduction tools for imaging, available as a 'notcam' package in IRAF was updated. The new version includes reduction of beams-witch observations. Also, in the new version the RA/DEC header keywords are used to define the dither offsets, which means that any dither pattern can be reduced. This was possible only after a bug in the RA/DEC values from TCS was corrected. The package will be updated with a reduction tool for polarimetric data in the future.

### 5.7.3 Polarimetry

We still have not had photometric conditions on a tech night since the Sequencer became available, so the high-pol and zero-pol standard star observations through the polarizers, cycling through all 4 polarizers per dither position, still remains to be done. The script is written.

A possible polarimetry upgrade for NOTCam and the associated cost are under investigation.

### 5.7.4 Detector

The varying 'dark-current' was thought to be caused by a design error of the printed circuit board (PCB) that sets the 'biasgate' voltages. A new PCB was designed and changes to the code of the detector controller were made by Preben Nørregaard (CUO). The new board and code were installed with the engineering grade array and tested to ensure no problems were encountered. After successful tests the detector was swapped for the new science array. Unfortunately the changes have made no difference to the dark current behavior, though it has now provided us with the extra biasgate voltage to adjust, which can be used to get a larger dynamic range at the expense of readout speed.

Because the change of the NOTCam bias voltages did not solve the problem with the dark current, the next idea is to modify the clock drivers. At the moment the clock levels are from 0 to ∼3.5V where the specification is for 0 to 5V. To get the higher level intermediate buffers will be mounted on the controller clock drive board that will convert the existing 3.5V to 5V.

Still, a major improvement has been the installation and commissioning of the science array. A web page with the commissioning report can be found at:

`http://www.not.iac.es/instruments/notcam/comm-sci-arr2.html and the`

A web page detailing the main characteristics of the array can be found at:

`http://www.not.iac.es/instruments/notcam/new-sci-arr.html.`

The new array is about 10% more sensitive than the previous science array and up to 60% more sensitive than the engineering grade array. It is cosmetically good-looking with $< 1\%$ bad pixels, of which most are located in one corner. It has one bad feature, about 33x13 pixels, centred at x=150, y=508. It has a very flat quantum efficiency over the whole area, even better than the previous array. Still some tests needs to be done to investigate the level of crosstalk between the different quadrants, determine the precise plate scale with the different cameras and map the photometric scatter across the field of view.

The interference pattern seen since mid 2007 is present also with the new array electronics and the new array, but at a relatively low amplitude.

#### 5.7.5 Wheel bearings

All worm wheel bearings inside NOTCam were exchanged in Nov-2007 during the preparation for the change of PCB and detector array (see above) following our preventive strategy of exchanging them every 2 years. None of the bearings were worn. This was also noticed the previous time (Nov-2005). Since this is a procedure that involves risks, we should re-consider whether the exchange should be done every 3 or 4 years, rather than every 2nd year. The first estimate was based on a very busy use of NOTCam, including the first test year, and without the ability to initialize one wheel at a time. Currently the wheels are turned less than before.

#### 5.7.6 Cooling

Finally we have received a working PTR rotary valve from Iwatani, Japan, through Kelvin International, USA. We had to send back our working unit for documentation and back-engineering. This was done in mid November and by the 19th of December the new upgraded unit arrived at the NOT and was immediately mounted on NOTCam. Apart from one incident of strange sounds from the unit, it has worked flawlessly since arrival. An extra back-up valve was supplied free of charge to compensate for the long time this has taken.

#### 5.7.7 Vacuum

When closing NOTCam again after the array electronics upgrade (see above) we did not achieve a good vacuum. After the installation of the Science Array NOTCam seemed to cope relatively well during the commissioning night 13/12, but over Christmas the leak was so strong that we had to let it warm up and open to examine the situation. During these tests we did not find the cause of the problem, and the January NOTCam runs had to be done with the pump attached to NOTCam on the telescope, pumping all the time. When finished, NOTCam was again examined and leak tests pointed to the entrance window. First the entrance window o-ring was suspected, but eventually a tiny crack was found in the window. It was exchanged with a spare window.

It had been noted that while NOTCam was in Copenhagen a vacuum better than $10^{-6}$mbars has been achieved, while since the instrument has been at the NOT we have never seen this. Following a review of the literature the whole instrument was baked to a maximum temperature of 40C for several weeks and more care was taken with handling of component when the NOTCam was open, i.e. use latex gloves always and not clean the internal surfaces or the O-rings with any liquids. Since then we have achieved a better vacuum than ever when pumping in a warm state, which made us believe we must have had a tiny micro-crack in the window for a long time. However, when cooling down there were some poorly understood vacuum losses and we only achieved a pressure of $10^{-4}$mbars which is not better than the typical pressure we had throughout 2007. A possible reason why we can not get a better pressure is now believe to be the slow degradation of all the O-rings which have been inside since NOTCam was made. We have purchased new O-rings for the main vessel and for the entrance window. There are various mostly small O-rings which are very hard to reach and remove with the risk that we might make things worse. The current plan is see what happens when we exchange these two main O-rings. If that does not improve things we are thinking about doing some vacuum tests with one of the smaller O-rings that can be easily reached and compare those with tests using a new O-ring to see if there is any significant difference which might explain the relatively poor vacuum.

## 5.8 FIES

### 5.8.1 Instrument

To limit light pollution on to the dome floor a baffle was made around the top calibration-unit Halogen lamp vent. A baffle should also be made around the fiber-spectrograph coupling, which currently lets in stray light.

The electronics of the FIES camera focus mechanism that was 'affected' by the lightning in March 2007 still needs to be repaired and we should purchase some more spare parts.

One recurrent problem is the mounting of the fiber arm on the top calibration unit. This often becomes mis-aligned and needs some proper fixing.

One thing that still needs to be decided is whether to upgrade the old fibre bundle to serve as a proper spare.

An exposure meter was received from Aarhus and after some investigation a proper local was found and the meter was recently installed. The main task now is to test it, particular under different weather circumstances, after which it should be determined how it can be incorporated in our system. One of the objectives is to be able to use the results from the exposure meter directly to determine when a certain signal-to-noise is reached in an exposure, instead of having to guess the required exposure time which is very difficult if the weather is not optimal.

### 5.8.2 Data acquisition

Several sequencer scripts were made to make observing easier. This includes a script that set-up the telescope for use with FIES, and a general calibration script that will provide a basic set of calibration data for the selected instrument set-up which can be used by the FIESTool quick-look/reduction program, and are sufficient for normal data-reduction requirements.

### 5.8.3 Target acquisition

The target acquisition will be further streamlined through the development of more integrated observing scripts. Also, the 'movie-mode' imaging with StanCam that is used to monitor the position of the star on the fiber entrance will be improved to provide a better view. As part of the preparation for remote observing with FIES during the NORDFORSK summer school in August a control panel with buttons will be developed to correct the star position on the fiber entrance. This same panel can also be used for normal observing.

### 5.8.4 Focussing

In principle there is one general telescope focus setting for all fibres. However, we will test the optimal telescope focus for each fibre in more detail by checking count rates at the FIES detector as a function of telescope focus. A script will be made to simply the focussing for FIES.

### 5.8.5 Solar experiment

A new web page that explains the setup of the solar experiment to measure solar oscillations using FIES by observing the blue sky with a bare fibre can be found here:

`http://www.not.iac.es/instruments/fies/staff/solarexp.html`

The experiment has been run on various occasions and from an analysis of the data short-term radial-velocity stability from blue-sky measurements was measured with a scatter of only 3m/s.

### 5.8.6 Calibration plan

A web page with a full 'Calibration scheme' listing all the necessary observations for calibration, Quality Control, and other monitoring purposes has been prepared. This page now also contains checklists for support astronomers.

Several calibration and quality control scripts were made. These scripts take data and analyze the data automatically. Still a script needs to be be made to monitor the radial-velocity stability of the system. Also, the results of the FIES detector quality control scripts and the results from the FIES standard-star efficiency measurements need to be incorporated in the main NOT database. A new data base will be made to record and monitor the performance of the calibration lamps. Scripts to obtain arc spectra will be made that determines itself the exact exposure time that is needed. The specify wavelength zero-point accuracy still need to be defined for observations with and without simultaneous ThAr mode.

#### 5.8.7 Reduction software

A help page concerning 'Frequently Asked Questions' for FIESTool was made and can be found at:

`http://www.not.iac.es/instruments/fies/fiestool/faq.html`

FIESTool itself was modified to improved the configuration-file management in order to allow for easy automation of the pre-reduction of calibration data for the online pipe-line. It is planned to further improve the program to enable automation of the pre-reduction of calibration images such that an online quick-look reduction can be offered in an easy way. It is also planned to improve FIESTool regarding the wavelength solution, allowing for new ThAr frames to be used automatically. There should also be way to use the ThAr frame obtained closest in time to the target spectrum.

#### 5.8.8 Detector

It is possible to readout the CCD using both amplifiers, which would cut the readout time nearly in half. This is of interest when using short exposures times. The only problem is that in the current set-up using this mode results in losing one column in the middle of the spectrum which basically removes a whole order from the resulting spectrum. It is in principle clear what the problem is, but the solution requires some work.

#### 5.8.9 CryoTiger

The FIES CryoTiger that cools the detector was not giving us the expected performance, the cold-head was only reaching -160C where we would expect closer to -200C. It was believed the problem was due to contamination in the system. The people at the Liverpool Telescope were consulted, since they have several CryoTiger systems and more experience in using them. They provide use with a manual and advice for cleaning the whole system, which we carried out. After filling with new gas we now achieving the expected -200C at the cold-head and a stable CCD temperature.

### 5.8.10 Temperature Monitoring System

A new temperature sensing control unit was installed that is less noisy than the previous ones. To get accurate temperatures noise is removed using a simple software filter. Accurate temperatures are necessary to relate any shift in the Echellogram to physical phenomena on the spectrograph table and for further tuning of the temperature stability.

To control the temperature in the building better various things are planned. Design and install active cooling for the front room to avoid temperature rise in warm periods, and improve FIES and building temperature-control loops, to make the excursions around the reference temperature smaller, and to avoid short oscillations (with period less than 2 hours). To monitor the effect of temperature variations an automated temperature-stability analysis tool will be made based on measuring shifts in the Echellogram.

### 5.8.11 Atmospheric dispersion corrector

When the ADC was first installed it failed for two reasons; the first problem was a mechanical relay failing, which was part of the arm movement control, and the second reason was during tests the spring that is part of the arm broke. Niels Michaelsen (CUO) provided a replacement (new designed) spring and we re-designed the arm control electronics, removing mechanical relays and now using a proper motor controller chip. The operation of the ADC has been successfully tested over long cables, this is so we can locate all the electronics outside the adapter. The electronics for both the arm and prism rotation have been mounted in a box ready to fit at a suitable external location on the adapter. The system still needs to be integrated in the TCS and the unit itself needs to be tested on the telescope.

### 5.8.12 Lightning protection

The new lightning protection for the FIES building was installed. We have had a storm with lightning at the observatory, but there have been no more problems in the FIES building.

### 5.8.13 Documentation

Further improvements were made to the documentation, both in the instructions for the support staff and in the user manual. New instructions were made on how to start-up the system and a section on 'troubleshooting' was added. A more condensed observing manual will be made as many basic sequencers commands (e.g., moving only the fiber arm or mask) are no longer used as separate commands and only scripts that define completed instrument set-ups are used.

## 5.9 MOSCA

### 5.9.1 Detector

During the last observing run we have had intermittent problems with one of the CCDs showing only 0's when the instrument was at certain orientations with respect to the telescope. The same problem has occurred in the past. On that occasion we decided to open the cryostat to make an inspection of a suspected wiring fault to the detector, but nothing was found. After mounting the instrument back on the telescope it was found that the affected CCD worked properly, but another CCD did not work at all and was later found to be effectively dead. We have done several tests on and off the telescope which shows that the particular CCD only shows 0's at particular orientations as before. Given our past experience we have decided not to do anything until after the next observing run which starts at the end of April and is the last observing run with MOSCA in this semester. Normal observations should be possible as long as we limit the orientation of the rotator which should not seriously affect observations, and we will review the situation after the observing run.

Another issue is that of including over-scan pixels for the detectors to be able to correct more precisely for the varying biases level. In the current controller there is not enough memory on the detector controller interface 'PC-board' to read the MOSCA array in full resolution (no binning) and to have an over-scan. It turns out that larger memory can be used and new 128MB memory was bought and installed on a spare PC-board and tested on an old instrumentation computer, but due to a design fault on the board it only finds the first 32MB. Further investigation found the other memory appeared at high addresses but with gaps at intervals of 32MB. This needs to be investigated in more detailed, but in principle it appears to be possible to modify the controlled as as to be able to read the full array plus over-scan. An increase in memory would also be beneficial to NOTCam as this would allow the 'frame' readout mode to be expanded to allow more sub-reads in a single exposure.

## 5.10 StanCam

### 5.10.1 CryoTiger

New hoses were mounted on the StanCam CryoTiger and it was moved back to its original place in the loft below the observing floor. We intend to buy a new compressor to have a full set of spares for the two systems (FIES and StanCam) in operation.

### 5.10.2 Detector

A shutter test was made which resulted in a revision of the shutter-delay correction applied. More tests will be done to determine the stability of the shutter-delay and see if there is any variation across the field of view.

## 5.11 SOFIN

A sequencer script was made to setup the telescope for use with SOFIN.

## 5.12 Computers and software

### 5.12.1 Network

The bandwidth of the network link from the observatory to Tenerife has been increased to 1Gb as planned. This link does not include the NOT sea-level offices, and together with the ING there is an agreement with the telephone company to get a 100Mb connection to the 1Gb network but this link is still not ready.

The computer network on the mountain was upgraded to have better gigabit connectivity. This includes more gigabit network sockets for NOT servers and desktop machines and the upgrade of the connection to the IAC network to 1 Gbit/s.

### 5.12.2 Observing system

Following the reported varying overheads with reading and storing images with NOTCam, a set of programs designed to record data about the environment in which observing programs (BIAS, sequencer, etc) are run, and analyze it. Currently we are able to measure CPU and network load, plus a list of the most CPU-hungry processes, twice a second. The probe program has been written carefully to be non intrusive, and to use as few CPU cycles as possible. Using this data we can correlate readout times with system behavior. The main goal is to find out the possible causes for overheads at readout time.

### 5.12.3 Computer cabinet

The current cabinet in the service building which contains the main rack of our computer and network system on the mountain is rather small. This makes access to the computers if there are problems very difficult and also does not allow us to have some devices (such as data recording devices) in there which would be better placed in this atmosphere controlled environment to protect them from the sometimes harsh circumstances at the mountain top. The current clean room is directly next to the computer cabinet and as we plan to have clean room facilities at the telescope (see above) using this room provides an easy and convenient solution.

#### 5.12.4 DVD Jukebox

As there was no clear solution to the continuous problems with the DVD jukebox the current system of using regular DVD recorders was further streamlined to limit the amount of time needed to record data each day. We still will look for possible solutions to the problems with the jukebox and we also plan to move it to the was is currently the clean room (see above) together with the computer rack, where we hope that the better environment will improve its functioning.

#### 5.12.5 General computer system

A significant amount of work was done on the general computer system. This included the following:

- **Time server**: A new time server was designed, constructed and configured that will be installed on the mountain to ensure consistent time information for all computers. The time server used by TCS is only available while the dome is open. The new system is also available to the TCS as a backup, in case of failure at the main one.
- **Web plus ftp server and Data-Base server**: Originally, the web plus ftp server at the NOT has been used not only for this task but also as a secure gateway for users to log into our network and to store and serve their private content. In order to improve security and our operation environment, this server has been split. Now there is a computer as the main NOT content server, meaning official web pages, plus ftp server for retrieving data (e.g., ToO) files; and a second computer which holds the accounts (new gateway), and staff's web pages. The web pages were migrated to the new web server in December and at the same time a complete switch was made to the new database servers.
- **Back-up system**: Finally, the policy for backing-up the computers was agreed and is now being implemented.