AiC Report to NOT STC
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Contents

1 Introduction

This report covers the operations of the Nordic Optical Telescope for the period 2002-10-01 to 2003-03-31.

We recently have started the use of a dedicated fault reporting system and data-base (see below). One of the implications is that we will be able to provide more detailed statistics on the number of fault reports (not necessarily the same as the number of end-of-night reports with faults in them), and their distribution by system (telescope, instrument, etc.) and fault type (software, mechanics, etc.). In that respect the section on down-time will change a bit in the future from the present form, though this will still include the very generally down-time figures as given below.

2 Down Time

In Table 1 the down time statistics for the period 2002-10-01 to 2003-03-31 are reported. The main change in the reporting of down-time with respect to previous periods is that we have changed the options for reporting down-time from '<1 hr', '2hr', ..., '10 hr', 'All night'; to: '5 min', '10 min', '15 min', '30 min', '45 min', '1 hr', '1.5 hr', '2hr', ..., '10 hr', 'All night'. The implication of this is that we can give a fairly accurate indication of the total time lost, not just an upper limit.

In a total of 50 End-Of-Night reports faults were reported, with an average time lost of 32 min per fault. Of these, 29 reported no time lost, 19 reported < 2 hr lost, and 2 reported 2 or more hrs lost.

Table 1: Technical down time statistic 2002-10-01 to 2003-03-31

Night included	Time lost	Nights	Percentage[a]	Last period
All nights	1590 min	182	1.5%	$< 2.8\%$
Scheduled observing nights[b]	1520 min	121	2.1%	$< 2.6\%$
Technical nights	70 min	28	0.4%	$< 5.1\%$
Visitor instruments	0 min	33	0.0%	0.0%

[a] Assuming an average of 10 hr per night
[b] Excluding technical nights and visitor instruments

This compares to a down time of $< 2.8\%$ over all nights ($< 2.6\%$ on scheduled observing nights) in the period 2002-03-12 to 2002-09-31 (which is slightly different from the period in the last STC report to be instep with the start and end of the semesters). In that period in 53 End-Of-Night reports faults were reported, of which 29 reported no time lost, 16 reported < 1 hr lost, and 7 reported 2 or more hrs lost. The main difference between the current reporting period and the last reporting period is the number of faults resulting in large (2 or more hrs) down-time.

Below are listed those faults for which 2 or more hours were lost. Also repetitive errors which lose little time but occur frequently are included here.

- **2002-11-08: Telescope motor brushes holder**: All night

  The holder of the brushes in the motor got burned as a result of short-circuiting due to aging of the brushes. Spares have been ordered.

- **2003-03-18: NOTCam filter wheel no. 2**: 7 hr

  The filter wheel no. 2 in NOTCam could not be moved normally. In the end it was possible to get the filter wheel to a fixed position, and the observed selected to observe with one filter per night. After opening the instrument it was found that the bearing of the wheel gear was stuck. It was replaced with a spare.

  The next time that NOTCam will be opened the bearing of the other filter wheels will be checked. It was noted that filter wheel no. 2 is the one that is most often used (it contains the broadband filters).

- **2002-03: Pointing**: 1 hr

  In various reports (with little time lost in each separate report) it was noted that the telescope pointing was of significantly. A new pointing model was made and installed (see below).

3 Instrument use

Table 2 lists the number of scheduled observing nights and technical nights for each instrument. This covers all nights, including CAT, CCI and guaranteed time. Note that StanCam is not included, but normally has been available when ALFOSC was not mounted. In this table I have also included the number of observing runs, and the number of nights per observing run for each instrument (note that for ALFOSC this includes 2 guaranteed time observing runs).

Turpol was not schedule during this period.

Table 2: Instrument use

Instrument	No. of nights		No. of runs	Nights/run
	Scheduled	Technical		
ALFOSC	101	14	33	3.1
NOTCam	17	5	7	2.4
MOSCA	10	2	2	5
SOFIN	19	7	8	2.4
SIRCA	7	–	1	7

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

As before, most comments written in the reports were very positive.

The only thing that was commented upon more than once was the observing log programme. Specifically, some problems occurred with a new version for MOSCA, and some when the programme was moved to a new computer. Currently there are no more problems, but we will review the programme and see if it needs any improvements.

5 Operations

5.1 Telescope

5.1.1 Wavefront sensing

New wavefront sensing data were taken in February 2003 to determine the aberrations of the primary mirror. The data was analyzed and compared to the data taken in March 2002. In general the results agree, with the focus, astigmatism, and spherical aberrations showing clear dependence on zenith distance. However, there are some (mostly detailed) differences between the results. Considering that in between the tests the main mirror has been taken-out for aluminization and we have had the problems with the mirror support pads, we want to double check these difference and we have additional tests scheduled for April the 11th.

The fact that no very big differences exist between the two tests does show that no major changes have occurred due to the aluminization or the problems with the mirror pads.

5.1.2 Pointing

A new pointing model was made after some complaints about the pointing. The model was calculate from 'on-the-fly' pointings (basically regular telescope pointings [made by any observer] which comply to some specific criteria), which do not require any dedicated observations. This model had a general offset of 11 arcsec with respect to the previous model and an RMS error of 5.90 arcsec. The offset shows that significant changes do occur with time. The RMS value is basically the same as the last model based on dedicated observations, which means that we can use these data taken 'on-the-fly' to regular check the pointing, and update it if necessary.

5.1.3 The new TCS

The programming of the new TCS has progressed much faster, and at the moment 72% has been implemented. Clearly the new work schedule for Ingvar has improve the situation, though still significant amounts of time are taken by other tasks such as regular duty, trouble shooting the current TCS, and other tasks (e.g., the pointing model, installing the time server [see below], etc.).

The software for the adapter functions, mirror servo and active optics have been completed. With the exception of some minor parts for the adapter, the hardware for the adapter and active optics have been ordered, and the hardware for the mirror control hardware has been delivered.

5.1.4 Time server

A time server module from TrueTime has been installed, but installation of the antenna and a no-brake power supply are still needed before commissioning.

5.1.5 Mirror cleaning

A start has been made with a monitoring programme of the zero-points, but the long absence of StanCam and the relatively poor weather during the winter has severely limited the amount of data. Furthermore, it is clear we need some dedicated software to be able to reduce this data in a quick way to limit the resources this is taking.

An agreement is made with the ING to use their reflectometer. One advantage of this is that also the TNG is using the meter, so this will provide a direct comparison between the reflectivity of the different mirrors which will provide a proper basis for a direct comparison of the different methods used.

For the time being we will perform CO_2 cleaning when considered necessary (visible dust) and possible (humidity not too high). The mirror washing procedure should be reviewed to see if we can make the procedure easier.

5.2 ALFOSC

5.2.1 Long-slit spectroscopy

Tests were made with a vertical slit. This showed much better read-out times for windowing, down to 5 sec for a window that allows background subtraction, compared to about 25 sec in vertical mode). However, tests are needed to find out how repeatable the slit wheel positioning is, as this is more critical for the vertical slits as they are positioned radially with respect to the wheel. Also, we would need better slits for regular observations.

For half of the available grisms the efficiency was measured. In Table 3 the total peak efficiency of the telescope plus ALFOSC plus detector for the different grisms are given as measured with a wide slit.

Tables with S/N versus magnitude for a given exposure time will be provided on the web to assist writing proposals.

Table 3: Grism efficiencies

Grism	Efficiency (%)
# 3	22%
# 4	28%
# 6	22%
# 7	26%
# 8	23%
# 10	25%
# 11	30%
# 12	26%

5.2.2 Multi-object spectroscopy (MOS)

Unfortunately the MOS CNC machine was found to behave unpredictable, so manufacturing of MOS masks cannot be made at the NOT for the time being. A preliminary agreement has been made with Per Kaergaard that Niels Michelsen (CUA) will take a look at the CNC machine when visiting the NOT in connection with ALFOSC work.

5.3 NOTCam

It is noted that the general progress of work on NOTCam can be found on the NOT web pages, as well as info on zero-points and backgrounds levels for different filters, and the results of monitoring of Gain and RON values for the detector.

5.3.1 Spectroscopy

Several slits and Hartmann masks were installed. Tests (on stars, as well as using the Hartmann masks) of the internal focus show that there is no problem focusing the Wide Field camera on the slit, but that we may need to modify NOTCam in order to get the High Resolution camera in focus over the full NIR wavelength range.

A dummy grism was mounted and tested. A grism which allow separate J (5th order), H (4th order), and K (3rd order) observations with spectral resolution of $\sim$2500 for a 0.5 arcsec slit width using the Wide Field camera has been ordered.

5.3.2 Cooling

The long hoses for the PTR have been installed, and the PTR works now permanently also when the instrument is mounted on the telescope. No problems have been encountered with the hoses as the telescope and rotators move during the night. Also, test observations has show no deterioration of the image quality due to vibrations from the PTR transmitted to the instrument down to a best seeing of 0.5 arcsec.

With the PTR permanently installed the detector is kept at a more stable temperature during the night, which means a more stable dark level. Also, it is much less vulnerable to spilling of LN2 then before.

5.3.3 The detector

Pickup in the form of horizontal bands can been seen in NOTCam images. An attempt to identify and remove the source of interference was unsuccessful. This noise can also be seen in images taken in Copenhagen. The conclusion is that the noise originates inside the controller. The only possible solution seems to be to remove the power supply unit completely from the array controller.

5.4 MOSCA

MOSCA was commissioned at the start of the semester, just after the last STC meeting. Most of what I write below has already been included in my report to the Council in November 2002.

MOSCA has been commissioned on October 18, 2002. Although the weather was not very good, with part of the time cirrus clouds and relatively poor seeing, it was possible to do most of the tests. Analysis has shown that the camera is well aligned, and that the PSF is stable across the field within the limits set by the seeing. During the commissioning night also observations were obtained of the optical counterpart of GRB021004 which provided support for the existence of a break in the optical light curve.

Tests of the CCDs showed very similar results to those obtained in Copenhagen before shipping. The gain and read-out-noise is practically the same for all CCDs at 1.3e-/ADU and 8.5e-, respectively. The shutter was found to been extremely accurate, having an average error of $\sim$0.002 sec with a spread of $\pm\sim$0.001 sec across the field-of-view. A minor problem was found with the data of one of the CCDs which was (in retrospect) also found to exist in test data taken in Copenhagen, but which does not affect the data in any significant way. The main limitation is the relatively low full-well capacity of one of the CCDs, which varies across the CCD, being lowest in the corner closest to the center of the mosaic at a level approximately twice as low as for the other CCDs.

The zero-point (in electrons) for the different broad-band filters are given in Table 4. They compare very well with the zero-points of ALFOSC, with MOSCA especially being more efficient in the blue as expected.

Under normal operations one would expected a data volume of various GB per night with MOSCA (which is a problem for archiving without the carousel). However, under many (if not most) circumstances 2x2 binning (providing 0.22×0.22 arcsec pixels) appears more than adequate, which reduces the data volume significantly and has the added advantage of a reduced readout time for a full frame of 37 sec compared to 113 sec for a 1x1 binning.

Table 4: MOSCA zero-points

Filter	Zero-point
U	24.6
B	26.2
V	26.0
R	25.7
I	25.2

Two visitor observing run have been made with MOSCA. Some minor problem have been encounter with the BIAS control software and with one of the FASU filter wheels, but the camera itself is performing without any problems. Up to now, the observers have selected to obtain all their data with 2×2 binning.

A further observation of GRB021004 was made during the night of November 3, 2002, which helped to constrain the brightness of the underlying host galaxy. The measurements of GRB021004 made with MOSCA have been included in an article which has been published the Astronomical Journal.

5.5 StanCam

5.5.1 Cooling

StanCam was fitted with a CryoTiger cooling system to keep it permanently cold. This includes a modified dewar and permanently mounted tubes between the camera and the compressor. Unfortunately, the tubes that were delivered were shorter than ordered (10m instead of 50ft). This meant that we could not install the compressor in the machine room as intended. We can operate it with the compressor in the dome, but this unit generates quite a bit of heat which is not really optimal and we do not have the system running permanently yet.

Tests with the camera itself were fine. Also, we did some tests with operating NOTCam + PTR and StanCam + CryoTiger (with the compressor in the dome) at the telescope at the same time. This also worked fine, with especially the different tubes not causing any problems. However, this remains to be confirmed when the CryoTiger for StanCam is permanently installed.

5.5.2 Filter mechanism

During the installation of StanCam a major problem was found with the filter exchange mechanism which was due to problems with the rubber belt that moves the filters in and out. This was repaired, but still some problems remain, and only 6 of the 9 filter slots can be used.

The filter mechanism has apparently never worked as specified, and we maybe should consider making a better system which is more reliable and easier to maintain.

5.6 FASU

5.6.1 FAPOL

FAPOL was commissioned on the 15th and 16th of February. Both linear and circular photometry and spectroscopy was tested. Also, the software by Roy Ostensen for the ‘fast-photometry’ mode was tested. All tests went well, except for a problem with the interlock to the calibration unit, which was fixed shortly after. Because of this, no calibrations using lamps were made. Quick and preliminary reductions of standards verified that we obtain the expected amount of circular polarization in the spectra. In Table 5 the transmission of the half-wave plate plus calcite per filter is given. Here, the efficiency is defined by the flux measured for a star in the ordinary plus extra-ordinary beam, divided by the flux measured when the star is observed with the filter alone.

Table 5: Half-wave plate plus calcite transmission

Filter	Efficiency (%)
U	57%
B	75%
V	77%
R	79%
I	81%

The retarder plates should be only changed by staff, therefore we do not recommend that linear and circular mode can be interchanged during a run. The default setup in FAPOL will be the half-wave plate. Per default, at least the calcite plate for imaging will be installed in case of GRB imaging polarimetry requests.

5.7 FIES

A meeting was held spread over 3 days in January with the NOT director, Soeren Frandsen (Aarhus University) and people from the staff on La Palma. This meeting has since been followed-up by extensive email contact over the past weeks. Plans have been discussed concerning the building (its design and location), the detector (including a CryoTiger), the optics (re-coating), the fibers (the length and the fiber head design), software for quicklook and pipeline reduction, and the installation of an ADC (where in the adapter). A general work plan was set-up, with as general aim to have the instrument ready for testing by autumn of this year. The ADC would be installed somewhere around new year. The main issue for the moment is the instrument building. The weather needs to be reasonable to be able to move the instrument from the telescope building without much risk, which means this will have to happen before October, or after March next year. Some problems have been encountered in the process of obtaining permits, but the current status is not clear and there might still be a change to get the building before winter.

5.8 Computers and software

Various software and computer changes have occurred in the past few months. Below I list the most relevant things for regular observers.

- The problems with the CD carousel have now finally been traced to a problem with the media. The current CDs we are using are not precisely the ones that are specified for the carousel, but the limited amount of errors can be handled by software. This is only a recent development, and the carousel is expected to be back in operation in the near future
- The observers 'reduction' computer ('florence') was replaced with a modern computer, and the installation includes now most software used by astronomers (IRAF, MIDAS, ghostview, acroread, etc.)
- A new observer terminal was introduced featuring a double TFT flat screen display
- A post-processing/quicklook system was designed and is being tested for spectroscopic data taken with ALFOSC. This system allows the images that has been produced by BIAS to be processed in various ways set by IRAF tasks coupled to the system

  In principle this system can be extended to include any type of post-processing of data produced by BIAS (e.g., bias subtraction and flat fielding of imaging data, slit alignment procedures, etc.)
- Some experiments were made with DVDs for data saving. We have been able to burn DVDs with astronomical data, but the software is far from stable. There is an on-going development in the open-source community which makes any definite choice difficult for the moment

6 Looking ahead

6.1 Autoguider

We have started looking for a new auto-guider camera. This will be essential for FRED due to the much smaller FOV of the camera. It is hoped a suitable complete commercial system can be found that ideally interfaces directly to the existing (and new) TCS hardware.

6.2 ALFOSC

6.2.1 Optics

The current plan is to install the new optics and detector for ALFOSC around September this year.

The idea is that during the same period that the installation of optics and detector is going on, an overall check-up will be made of the whole instrument.

6.2.2 Detector

Scripts are being made to perform Gain and RON noise tests, analysis the data and present the results in graphical form on the web.

6.2.3 Long-slit spectroscopy

A new design has been made for a grism with a resolving power of ∼2000 in the blue, as this isn't provided in the current set of grisms. The grism would cover the wavelength range 3550–5100Å, and a quotation for such a grism has been requested to get an idea of the price. When we get a quote we will present this plan to the corresponding Instrument User Group.

6.3 NOTCam

6.3.1 Shutter monitor

In the past there were problems with the NOTCam shutter getting out of sync, and a monitor consisting of two lights to show its status was installed. These lights are hard to see, and require constant attention. To improve this situation, a unit has been made to try and detect when the shutter goes out of sync and sound a buzzer. There are still some teething problems, but this system is expected to be in operation soon.

6.3.2 BIAS

We are still awaiting the implementation of the 'ABORT' command in the NOTCam BIAS programme. Further improvements to BIAS to increase the readout speed will have to wait until the new controller for the detector array is available.

6.3.3 Detector

Scripts are being prepared to automatically calculate Gain, RON and linearity for both read-out modes modes. Preliminary results using test data from January and March 2003 show that the median values are very stable for both modes.

6.3.4 Filters

We are looking in to the possibility of getting a focus pyramid to make focusing with NOTCam faster and easier.

6.4 MOSCA

The set of 100mm SDSS filter for FASU is still missing a g' filter. This has been ordered, but delivery has been delayed.

6.5 StanCam

6.5.1 Cooling

We have been informed that the correct size tubes are now underway, and they will be installed and tested as soon as possible after they arrive.

6.5.2 Filters

We are looking in to the possibility to define a fixed set of broad-band filters which are 'permanently' installed in StanCam. This to increase the stability and reliability of the instrument, which is also of interest for the program to monitoring the telescope efficiency.

6.6 FASU

6.6.1 FAPOL

A web page on FAPOL with "commissioning results", "user's guide", and "staff setup instructions" is under preparation. The old and obsolete web pages on polarimetry with ALFOSC will be removed. Some remaining commissioning test data will be obtained on the April 25th tech night. The first visitor run is on April 26th.

6.7 SOFIN

Developments are underway to enhanced the spectropolarimetry mode of the SOFIN spectrograph, including a new cross-dispersion prism with higher refraction index for a larger separation of echelle orders necessary to record two polarized beams in one exposure. A new calcite will replace the old beam-splitter for the larger separation of the polarized beams. The commissioning of the new spectrograph elements are planned in June and September of 2003.

Further modifications of the polarimetry mode will possibly include the replacement of the quarter wave plate to improve the achromatic properties, and the design of the additional fixed but removable quarter wave plate in order to increase the amplitude contrast of the linear polarization modulation curve and increase the signal/noise of these polarization features.

Mechanical modifications are considered to minimize ghosting, and to accommodate the installation of a more sensitive Loral CCD with the low resolution camera.

Also, a new C++/Linux software code is in development for the optimal extraction and analysis of the polarized spectra.

6.8 Computers and software

6.8.1 Fault report system

A new fault reporting and data base system has become operational as of the 1st of April. The main aim of the system is to allow a better way of keeping track of problems and their solution by relying less on person-to-person communication and individual memories. This should be more efficient as there is less need to talk to the 'right' person, while this might also avoid time loss when a problems recurs. The system also provides a simple way to do more detailed statistics of the fault report, which will make reporting easier and more complete, with the potential of giving us a better inside in what is required to let the telescope operate in an optimal way.

6.8.2 Development plan

Over the past few months we have discussed various aspects of software development at the NOT. We have been discussing the different parts to decide which tasks are most necessary and prioritize them accordingly. This is an on-going process.

Below I list the different tasks that have been considered.

- *Computer system*: this covers moving the NOT web site to a new and faster computer, have a new home directory server running a single login system based on NIS/NFS, move the mail services to a new and faster computer, increasing the speed of the local network, and incorporating 5 new staff desktop computers. *This has mostly been completed*
- *Computer applications*: define a fixed set of application (IRAF, MIDAS, ghostview, acroread, etc.) provided on each computer (including the observer's reduction work station). This should reduce the amount of maintenance and increase the stability of the system. *The list has been defined, and the software is being installed in the computers*
- *Interface between instrument control software and the telescope system*: this covers things like having the telescope focus automatically corrected when changing filter, having the status of calibration lamps in the header, having the status of the autoguider in the header, etc. A proper interface with the resulting header information in the data files are also essential to any pipeline reduction system, quality control system, and archive system (including the use of the data in a Virtual Observatory system). *We have already defined the general design for a system that will cover the interaction between instrument, detector and telescope, where FIES+StanCam will be the first instrument to be integrated*

- *Scripts*: this covers scripts to take test data (e.g., to test the detectors), maintenance scripts (e.g., scripts to 'clean-' and 'set-up' the observers' data reduction computer after each observing run), pipeline reduction programs, etc. In principle these scripts will be part of maintenance and calibration plans for the computers, and the instruments and telescope. *Some of these scripts exist or our being developed, but they will have to be integrated in overall maintenance and calibration plans, which remain to be defined*

- *Web pages*: The idea is to improve our web pages. Specifically, simplify the set-up and limit the amount of cross links. This should improve both the use and the maintainability. *No specific plans have been defined yet*