NOT NEWS

No. 3 *** January 1991

Nordic Optical Telescope Scientific Association

Gravitational Lenses observed with the Nordic Optical Telescope

-Flexible Scheduling enables Successful Utilization of Periods with Very Good Seeing

Ralph Florentin Nielsen

Observations in August and September 1990 of gravitationally lensed quasars have clearly demonstrated that the Nordic Optical Telescope performs remarkably well. Several CCD exposures have yielded point spread functions of 0.50 - 0.55 arcsec, FWHM.

In 1988 a group consisting of S. Refsdal, Hamburg, R. Stabell, Oslo, J.-E. Solheim, Tromsø and RFN formed in order to study gravitational lenses with the NOT. Since then several others have joined the group. Refsdal is an internationally renowned theoretician in this field, and RFN has since 1982 observed the lens system Q0957+561 A,B (the „Double Quasar") with the Brorfelde Schmidt telescope. Continued photometry of the two images of the QSO formed by the gravitational field of an intervening cluster of galaxies at a red-shift of z = 0.39 is carried out in an attempt to determine the difference in light travel time along the two paths. If well established, this time difference, Δt, can be used to determine the mass of the galaxy that lies between the two QSO images, including dark matter and any non-baryonic mass. Furthermore, Δt will put limits to the value of the Hubble parameter, and thus of the size and age of the universe. The Brorfelde observations suggest Δt = 1.55 years, corresponding to a mass of the central deflecting galaxy of $1.1*10^{12}$ solar masses, and a Hubble parameter, $H_0 = 77$ km * s^{-1} * Mpc^{-1}, and $H_0^{-1} = 13 * 10^9$ years. 1), 2).

However, the value of Δt is still quite uncertain, and it is even not certain that the brightening of the A image and later the B image are in fact due to the same physical event in the QSO. It is therefore important to obtain much more observational data.

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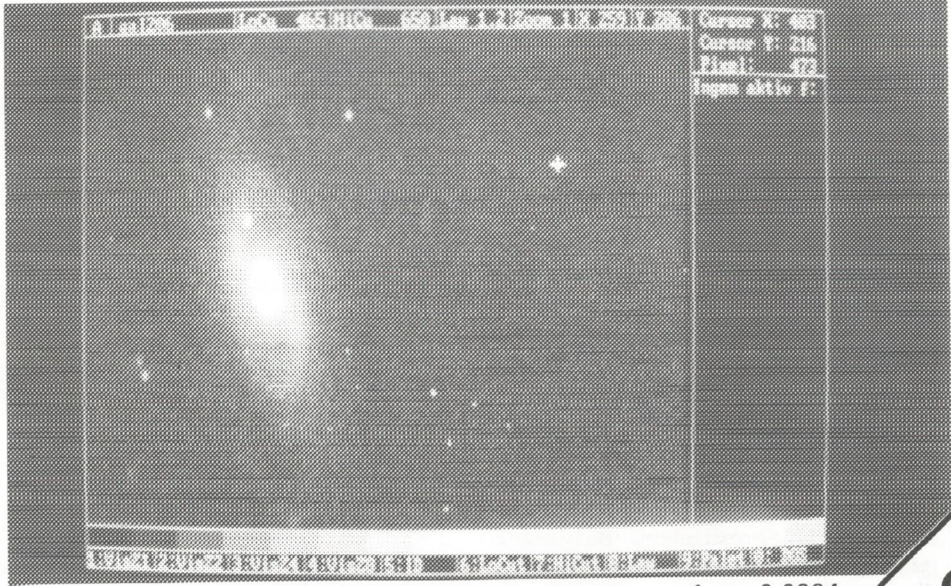

Figure 1: The quadruple Q2237+030 sits in the center of a z=0.0394 spiral galaxy. 5 min R exposure with the NOT stand-by CCD camera.

Today's menu

Scandal

Maybe you thought that ast... are immune to scandals. W... they are not. Best proof... the scenes dominati... est meeting of the scie... n recently. Here, Dr. ... was, no doubt among t... most excited, and i... ented in an absolutel... e manner. He even w... se his colleague, Profe... e often seen as an ex... f attitudes otherwise ... o accept. Well-informed ... ent as far as claiming that ... d accuse all members of the ... o have arranged the appalling ... cident merely to have access to ... onfidential documents.

Body and Soul Issue

Velux Spectrograph

In NOT NEWS No. 1, we could report that the Velux foundation had granted a sum of DKK 1 537 000 for a new spectrograph for our telescope. The spectrograph project is now well on its way.

The spectrograph will be operated at a resolution of between 20.000 and 80.000. The design will closely follow the scheme previously developed by Lawrence Ramsey from the Pennsylvania State University. Lawrence has kindly served as a consultant to our project and assisted in specifying essential parts of the system.

The spectrograph will be fitted to the side of one of the arms of the telescope azimuth structure, near the (non-existing) Nasmyth focus. It will be housed inside an insulated and temperature controlled box. The spectrograph will be mounted on a standard optical table, essentially using commercially available components. It will be fiber-coupled to the telescope in a stand-by mode. Thus, the spectrograph will continuously be ready for use and may go into operation in less than a minute.

The Scientific Technical Committee of NOTSA has formed a sub-committee in order to assure that the specifications of the spectrograph fulfil the needs of Nordic astronomers. Members of the committee are Søren Frandsen (Chairman), Tarmo Oja and Leo Takalo. Anders Reiz, who formulated the project and acquired the funding from the Velux Foundation is expected to continue as scientific coordinator on the project. The spectrograph will be designed and constructed by the Nordic Telescope Group with Søren Dybdal, mechanical engineer, as responsible for most of the technical work. In a meeting in February, a few remaining technical details will be discussed and finally specified. Since the instrument is a bench-type spectrograph, it should be feasible to terminate the project reasonably soon. Thus, it is expected that the spectrograph can be tested on the telescope already around or somewhat after the end of this year.

In a forthcoming issue of NOT NEWS, we shall describe the Velux spectrograph in more detail.

Editorial

In the two editorials preceding the present one, daring attempts have been made to promote an easy feeling of optimism and progress. This is typical for the phase prior to the period of science programmes. With a major part of the time devoted to technical work and tests under suitable conditions, performed by the people who made the instrumentation, it is only normal (and exceedingly tempting) to produce happy noises and pretty forecasts.

Now, these favourable times are gone and we are sitting with real, critical observers in all corners. Disturbing as this situation might seem, nevertheless we feel like insisting on basically optimistic intonations. On the one side, we feel (unfortunately) obliged to admit that we are still not in control of all details. On the other side, we love to note that several (more than one) critical (closely collaborating) observers have publicly (in the presence of a keen listener) given credit to the quality of our telescope (they will of course get more observing time). Still needing, and receiving, more attention, blind pointing and tracking have improved. So has, in parallel, the performance of auto-guiding. Yet not working entirely perfectly, the telescope building has, gradually improved its track record and today presents little problems even to demanding users. Being in its first phases, thermal control is steadily gaining power. And last, but certainly not least, observers still grant us delirious happiness, enthusiastically praising the quality of their images, making terrifically favourable comparisons to other images. We might, in the end, start feeling that we do not have to resort to the ever so popular habit of intensity cutting, emphasizing telescopic well-being. As has been said before, there is no prohibition against (friendly) users submitting their roses, ideas and (constructive) criticism. Subject to careful selection, we may even choose to publish your contributions.

The Nordic Optical Telescope (NOT) Scientific Association was founded in 1984 to construct and operate a Nordic telescope for observations at optical and infra-red wavelengths. Associates are Statens naturvidenskabelige forskningsråd, Denmark, Suomen Akatemia, Finland, Norges almenvitenskaplige forskningsråd, Norway, and Naturvetenskapliga forskningsrådet, Sweden. Executive bodies are the Council and the Directorate. Advice and assistance is provided by a Scientific-Technical Committee.

The Nordic Optical Telescope is a 2.56 m telescope with altazimuth mounting and Cassegrain focus. The primary mirror has a focal ratio of f/2.0, the combined optical system a corresponding focal ratio of f/11.0. The telescope is installed at Cruz del Fraile, Observatorio del Roque de los Muchachos, La Palma, Islas Canarias. Geographical longitude is 17° 52' 59.7'' West, geographical latitude 28° 45' 20.5'' North, and altitude 2382 metres above sea level.

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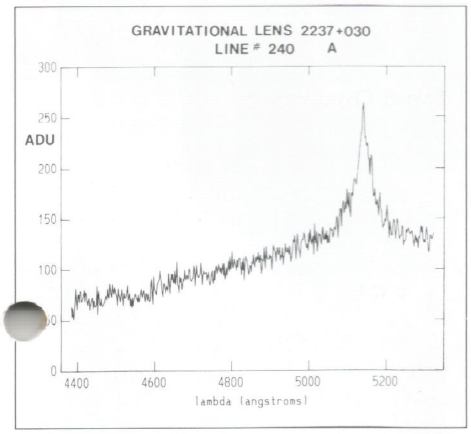
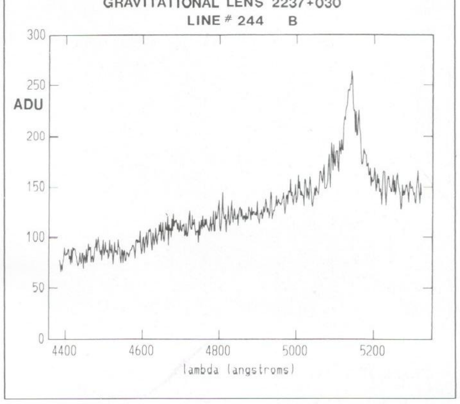
Commissioning of the Low Dispersion Spectrograph

Bjarne Thomsen

Current Status

This is a summary of the status of the Low Dispersion Spectrograph (LDS) after the commissioning period on NOT during October 3 - 9. The laboratory (my office) testing of software and hardware was essentially finished by the end of August, and the instrument was shipped to La Palma in September. During the final testing a rather large leak was discovered in one of the Dewars, so the LDS had to be commissioned without the P8603 (GEC) camera, which is normally used with the primary channel. The LDS was unpacked and mounted on NOT during the first days of October. The first exposures were quite exciting, because this was the first time that the LDS had been mounted on a telescope in a real dome environment experiencing outside temperatures and changing direction of gravity. The LDS is actually the first instrument that we have constructed in Aarhus, which has not been tested on our 50 cm telescope. Nearly all the problems encountered during the first few days and nights had to do with the influence of the dome environment on the LDS hardware. The software, on the other hand, gave us only very few and minor problems. Most of the hardware problems have been solved, or they are in the process of being solved. The list of unsolved problems is not long, but we found that the primary shutter refused to open, and that we may have a flexure problem when the telescope is pointing at certain directions in the sky. At present it is not clear where the cause of the flexure is located, and any corrective action must await further tests of the LDS on the telescope. The shutter problem should be more straightforward to solve, but it may be necessary to change the shutter if it has been damaged. Though it is risky to take long exposures at present it should be safe to take exposures shorter than say 10 min.





Two spectral scans through the brightest components of the Einstein Cross gravitational lens system.

First Results

At this point you may get the impression that the commissioning period was a long row of problems. This is, however, not the case. The secondary channel with the new thinned blue-sensitive Tektronix CCD worked quite successfully during the latter half of the period, and we obtained both photometric and spectrographic exposures of selected spectro-photometric standard stars, as well as exposures of some interesting astronomical objects. As an example we obtained four 30 min long-slit exposures of the gravitational lens system 2237+030, (the „Einstein Cross") at a spectral resolution of 1.9 Å/pixel. The spatial resolution along the slit is 0.5 arcsec/pixel. The adapter was rotated so that the two brightest components (green magnitude 18), A and B, of the gravitational lens both fell on the slit. The two objects are separated by 1.8 arcsec corresponding to 4 pixels. The slit width was 1.1 arcsec. The four exposures were first flat-fielded for small scale detector variations. Then they were sky subtracted, and finally wavelength calibrated using a calibration exposure of an HgCd spectral lamp. The reductions were done by means of the spectral packages of the NOAO IRAF reduction software. One pixel wide spectral scans through components A and B are shown in the Figure. The intensity is given in Analogue Digital Units (ADU's). One ADU is equal to 2.6 electrons. The readout noise is 6.5 electrons rms. The useful spectral range for the grism used (600 grooves/mm) is from 4400 Å to 5300 Å. The strong QSO emission line is CIII L1909.

Measured Efficiency

In NOT NEWS No. 2 (Fig. 4) I gave the calculated efficiency of telescope, optics and CCD. It is of considerable interest to compare the curves given there with actual observations of a spectro-photometric standard star. So the optical spectro-photometric standard G191B2B was observed through the Strömgren v, b and y filters. The transmission curves for these filters being known it was possible to derive the total efficiency of the telescope, optics and CCD combination at the equivalent wavelengths of the v, b and y filters (4110 Å, 4680 Å and 5480 Å). The derived efficiencies, excluding atmospheric extinction and filter absorption, are 11.2% (v), 19.3% (b), and 24.7% (y). These values are 30-50% lower than the ones read from the curve given for the Tektronix CCD mounted on the secondary channel. Hans Kjeldsen has also done a linearity test which shows that the detector is linear over the whole dynamic range.

Gravitational Lenses observed with the Nordic Optical Telescope

....................continued from page 1

Ralph Florentin Nielsen

Due to the high resolving power of the NOT, this telescope is particularly well suited for this kind of work. The group was granted observing time in September during a period, when also V. Piirola was allocated observing time with the polarimeter. Our observations were carried out with the stand-by CCD camera, which is permanently mounted on one side of the Cassegrain Instrument Adapter, and which was kept permanently cooled during the observing run. Changing from one instrument to another at night time was performed literally in seconds rather than minutes, and we wish to acknowledge the good will of the other observing team.

Jan Teuber and RFN observed three interesting gravitational lens systems. Of special interest was Q2237+030 (also named the Huchra quasar or Einstein cross). In this system four images are seen of the same distant QSO through the central parts of a relatively nearby galaxy ($z = 0.0394$). Here the expected difference in light travel time is of the order of one day. Hence, it is not suited for testing the Hubble parameter, but it is a prime candidate for observing micro-lens high amplification events, as the four light paths from the quasar all pass through the central part of the deflecting galaxy, which is densely populated by stars. B. R. Pettersen and T. Korhonen reported that they had used this object in August to test the image quality of the telescope, and on a night of 0.5 arcsec seeing they found that the B-image had become brighter than the A-image. We observed the Einstein cross in broad bands (B, V, R) together with a narrow band at 5150 Å, centered at the red-shifted [CIII] line in the QSO spectrum. By combining light curves of variations in the continuum and emission lines we can hope to test the geometry of the QSO. It is widely believed that quasars are super massive black holes surrounded by a compact accretion disk which is the source of the continuum radiation and an extended cloud of a metric size of light months to light-years producing the emission lines. If one of the light paths from such a source happens to pass a star in the deflecting galaxy, then a characteristic variation in the flux somewhat similar to that of a star being occulted by the Moon may be observed. The flux variation due to micro-lensing is much more pronounced for the compact continuum source than for the extended continuum source. By studying well sampled light curves of such events one may deduce the geometric structure of the QSO with an angular resolution of 1-10 micro-arcsec. !

The other systems studied are Q2345+007 and Q0142-100. The latter of the two is particularly well suited for determining the Hubble parameter as the expected value of Δt is of the order of 50 days, and even more importantly, the deflector plane

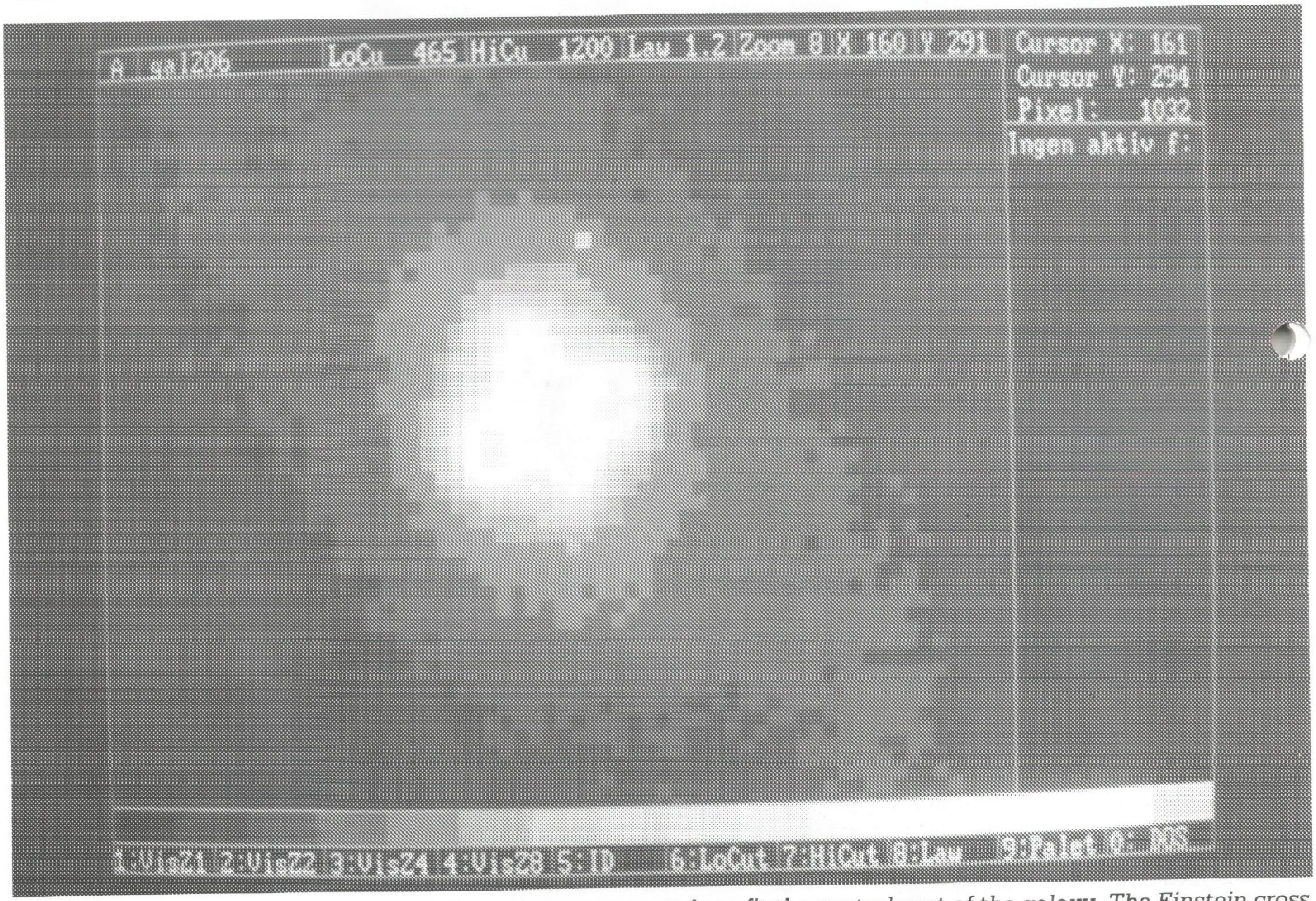


Figure 2: Same exposure as in Figure 1. Intensity cuts are made to fit the central part of the galaxy. The Einstein cross is clearly seen in this X8 zoomed display. The fine spatial sampling of the CCD camera (0.2"/pixel) makes it possible to deconvolve the images effectively.

is much less crowded, so a well determined Δt would result in a more reliable value of H_0. Q2345+007 is a well separated system, in which the deflecting mass (galaxy) has not yet been found. It is, however, important to know the exact location of the deflector, but as we consider the NOT to have the potential of reaching very faint limiting magnitudes on nights with excellent seeing, we will utilize one night of the monitoring time that we have been allocated to make a very deep red exposure in an attempt to detect the deflecting galaxy.

Throughout our observing run the telescope functioned perfectly. Even with the optical encoders not yet integrated in the telescope control system we made one minute test exposures that yielded sub-arcsecond images. Also, I wish to acknowledge the extremely helpful and competent introduction to operation of the telescope given by Hans Kjeldsen and Øystein Olsen. Their efforts helped a great deal to make the observations so successful. In the continued gravitational lens monitoring programme, Kjeldsen and Olsen will even do most of the observing. Øystein Olsen plans to do his thesis work on gravitationally lensed quasars.

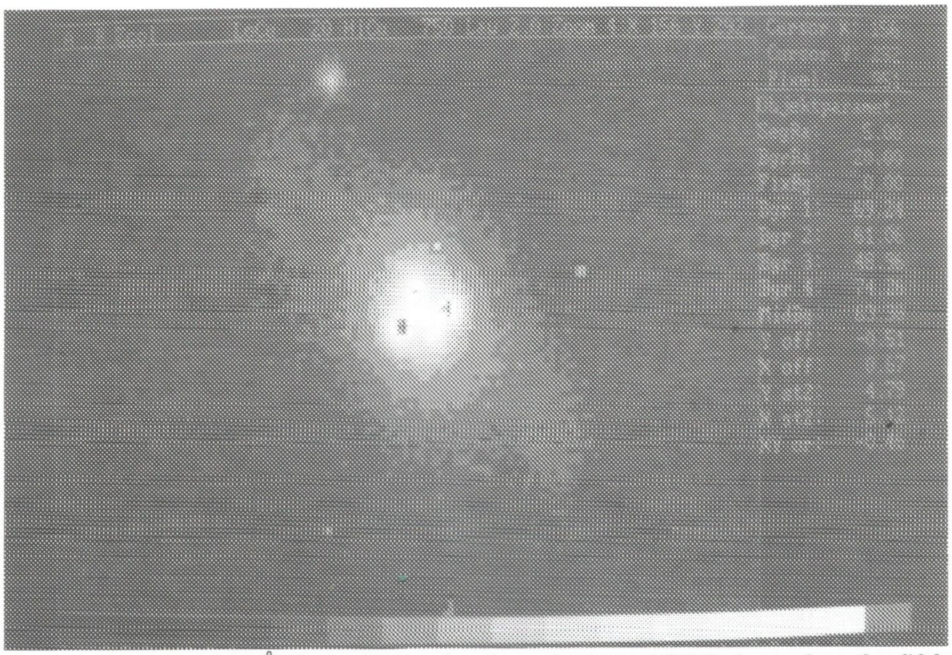


Figure 3: The R-5150Å colour index for the galaxy and QSO show that the fifth central peak in the Einstein cross is much redder than the other images. This fifth image is found not to be a QSO component but a central source in the deflecting galaxy.

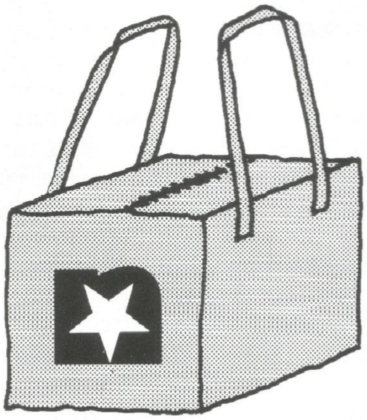
The CCD images are now being processed by a set of image processing and data reduction programmes that run on an ordinary PC AT. In another article there will be a description of these programmes and other tools for CCD observations with the NOT.

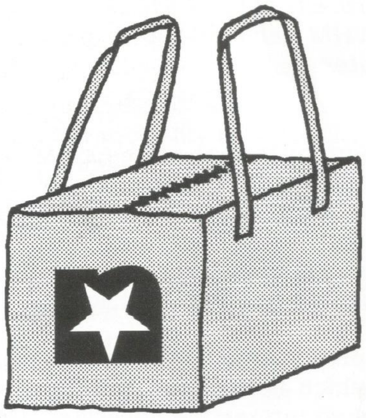
References:

1) U. Boorgest and S. Refsdal, A&A, 141, 318, 1984.

2) R. Florentin Nielsen, A&A, 138, L19, 1984.

Data Handling





People travelling to La Palma often carry a lot of stuff. Observers and engineers have a habit of bringing technical devices to the observatory and take home bulky data (in addition to bananas and other taxfree articles). Many of us have spent hours packing all kinds of gear into wood or cardboard boxes. To make life easier for such hard struggling people, NOTSA has bought a number of transport bags of the sturdy type often used for diplomatic mail and the like. Such bags may be borrowed on the mountain by contacting Paco Armas. After your return to your institute, we ask you please to hand the bag over to somebody else bound for La Palma. The bags love flying...

Guide Stars

Surely, when observing with the Nordic Telescope, you want to use your observation time as efficiently as possible. One important way to pursue this goal, is to find suitable guide stars already before leaving for La Palma.

If you choose to use the Palomar or ESO/SRC Sky Survey Charts you may profit from the existence of a small mask that shows the field covered by the guide probe. The mask can be placed over the Sky Survey Charts and the offset coordinates of suitable guide stars can directly be read from the mask.

The mask and a small instruction sheet were produced by Ralph Florentin Nielsen. Observers can get copies by writing or faxing to NOT in Lund.

ESA Photon Counting Detector on the Nordic Optical Telescope

Malcolm Fridlund

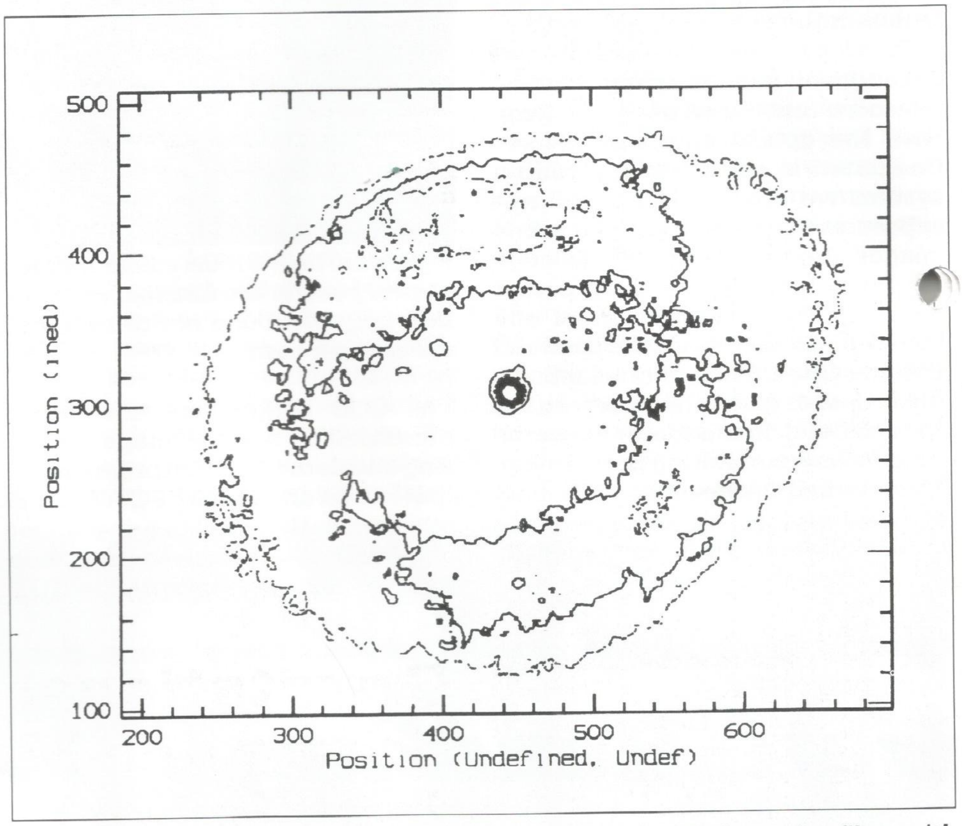
Through an agreement between the Astrophysics Division of the Space Science Department of ESA and the Nordic Optical Telescope Scientific Association, the newly developed Photon Counting Detector MkII (PCD2) will be available as a common user instrument on the NOT. A recent test program has just been concluded, and as a consequence the instrument can be used from the period starting April 1991. This article is a short introduction to make potential users aware of the properties of the PCD2, and what impact it might have on their science.

History

The development work on the PCD2 started in the end of 1985, as a consequence of the work done until then by ESA on the Faint Object Camera (FOC) for the Hubble Space Telescope. The rationale for developing the instrument was to gain know-how for a potential FOC MkII or for photon-counting systems on other space missions. A model was ready for tests in August 1989 and the first observations were carried out at the NOT in January 1990. Development work is continuing (to some extent in collaboration with the NOT organization) and will be described in a later article.

The Instrument

The detector front end consists of a bialkali photocathode and an unfilmed Z-plate Micro Channel Plate (manufactured by ITT). This is fibre-optically coupled by a taper to a 288 x 385 GEC CCD. This CCD is read out every 20 milliseconds and the output of the front-end is fed to the digital signal processing and pixel memory unit, where it is run through a novel processing algorithm leading to event centroiding of 0.5 or 0.25 of a CCD pixel. The detector formats on the face plate is then either 576 x 770 22 micron times 22 micron pixels or 256 x 1540 22 micron times 11 micron pixels. At the NOT Cassegrain focus, the former format corresponds to a pixel size of 0.17 arcsec, nicely complementing the Stockholm CCD Camera with its 0.2 arcsec pixels. The detector is linear for count rates above 0.5 events per pixel and second.



Figurtekst: M 57, the Ring Nebula, exposed with the PCD through a filter with a FWHM value of 200 Å and centered at 3223 Å. The exposure time is 10 minutes.

The pixel memory is seen on a monitor which is updated continuously, allowing interactive observing. Control and data acquisition is handled by a dedicated MicroVax II computer on which both the control program and MIDAS (old version) are running. The DQE measured in the lab is 15-20% in the wavelength range 3000 to 4800 Å and drops to below 10% at 5100 Å. At H-alpha the DQE is down to 1%. There is a provision for cooling, but it has not been necessary to use this during any of the testing.

The detector can be used in both imaging mode and as the detector on the Boller and Chivens spectrograph (not yet implemented). When this spectrograph gets into regular operation on the NOT, gratings will be available that cover the wavelength region 3000 to 5500 Å with a resolution of about 5000 and a grating efficiency of above 60%.

In imaging mode two filter wheels mounted in series allows the use of up to 14 65 mm filters. Due to safety considerations (see below), we do not allow changing of filters during night time, and for changing of the filters in the front wheel, the detector needs to be taken off the telescope. However, 7 filters can easily by changed during daytime.

A set of 55 high quality (imaging, blocked to 1 micron) narrow band filters is available. They cover the wavelength range from 3000 Å up to 6000 Å. The filter list is found in the manual.

Operations
You are asked to observe and study the warnings detailed in the box attached before proceeding with the text below.

The detector is operated from a Tektronics terminal on which the control program EXPO2 is running. EXPO2 can be operated without the detector connected thus allowing training before observations. The control program is menu driven and very easy to operate. A resulting frame (image or spectrum) is stored in MIDAS BDF type format and can be copied or backed-up to TK50 tape (note that TK70 type tapes do NOT fit the tape drive). Tape cassettes have to be brought by the observer. If MIDAS is not available at the home institute of the observer, we recommend using MIDAS on the MicroVax II to convert the data into FITS format. (Old MIDAS BDF format - the output of EXPO2 - can be read by the new portable MIDAS but not vice versa). Compared to observing with the CCD Camera where you cannot see your results until the exposure is over, observing with PCD2 is very convenient and efficient. As soon as the observing parameters (exposure time, comments etc) have been set, an integration can be started. The integration can be terminated interactively if the desired S/N ratio is obtained before the intended exposure time is over, or it can be suspended. The previous data can be inspected during subsequent exposures, using MIDAS and a program that plots images on the Tektronix screen.

The dark count on the uncooled detector is about 1 count per pixel and hour rms, and flat-fields are obtained by stopping the telescope and integrating on the sky. This is preferably done at dawn or dusk because of the low sky background through the narrow filters. Stars that pass through the field of view will sweep through so quickly that the centroiding algorithm can not keep track of the events. For this reason, passing stars do not lead to any interference with the flat field exposure.

How sensitive is the detector?
The sensitivity values quoted above refer to tests performed in the laboratory. If we want to find out what they mean in reality, we have to take into account the filter transmission, the reflectivity of the optics and the behaviour of the atmosphere. We are in the process of evaluating the response but some appetizers can be quoted from our test observations.

The ring nebula, M57, saturates the detector in 20 msec, when observed through a 20 Å wide filter centered on the [OIII] at 5007/5009 Å. The giant HII complex NGC 604, in the nearby spiral galaxy M33, is visible on the TV screen on-line - that is the read-out every 20 msec has enough events accumulated to detect a bunch of stars between magnitudes 15 and 18 in V. These observations are made through 40 Å wide filters centered on the continuum at 4740 Å. During observations of the HH object HH29 (integrated V magnitude is around 16), one hour exposures through 20 Å filters centered on [OII] 3729 Å, and [OIII] provided S/N ratios of between 20 and 100. The responsive quantum efficiency, as calculated from observations of white dwarf stars, give values of the order of 5%. More information will be provided in the manual.

It was noted that even at 5000 Å, where the CCD camera at NOT has about 3 times higher QE, the advantage of a counting system is such that the real time observing efficiency is a factor 4 higher for the PCD, so we recommend its use for observations out to about 5200-5300 Å.

Warnings !

Two warnings have to be issued:

1. The voltage on the intensifier is of the order of 5000 V. Caution!

2. The detector can be damaged or ruined by too much light. It is, at any moment, strictly prohibited to have the lights at the observing floor and the high voltage to the detector switched on at the same time. There is a shutter with a tripping mechanism in the front end but the reaction time of the circuit is such that a strong light pulse will ruin the detector before the shutter closes completely.

Gravitational Attraction of Norwegian Mountains pulls Øystein back

Visitors and staff alike, all will miss him. And social life in Santa Cruz will loose some of its pitch. Firm in his mind, at the time of writing, Øystein Olsen has his tickets reserved and packing under way. After a year with our telescope and its surrounding island, he returns to icy Norway. Some like it cool..

With his enthusiasm and friendly personality, Øystein carried a large load and turned out invaluable to visiting astronomers. We all want to thank him for his contributions to our project. At the same time, we wish him good success in his work on effects of gravitational lensing.

Engineering Tools used by the

Telescope engineering is a happy marriage between different technological disciplines. For the design of telescopes and their instrumentation, it is necessary to make use of specialists within various fields and to have a variety of different engineering tools at disposal.
Below, engineers of the Nordic Telescope Group present some tools that are frequently used by group members.

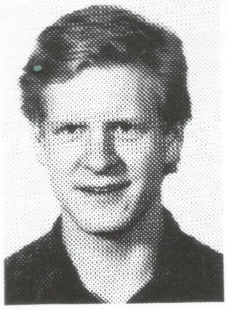
Finite Element Analysis

Søren Dybdal and Ole B. Larsen

Telescopes and astronomical instruments usually have many optical elements. Normally, such elements must be positioned mechanically within strict tolerances. Furthermore, rotation of telescopes during observations leads to gravity deformations in the mechanical structures. It is essential to predict such deformations to a high precision. Thus, it is not surprising that computer methods for structural engineering found one of its first uses within telescope engineering.

Søren Dybdal

The normal approach is to subdivide the structure into a large number of small standard elements for which mathematical solutions for computation of stress and deformation exist. Thus, a *finite element model* is established in the computer. It is the task of the engineer to subdivide the structure into various finite elements. The computerprogramsets up the boundary conditions between the various elements and calculates the performance of all of these.



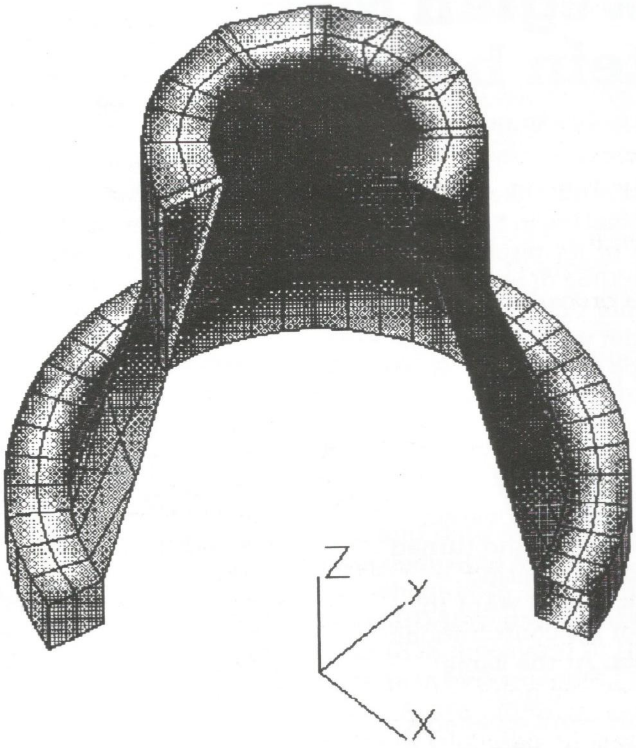
Ole B. Larsen

Usually, many finite elements are needed to model a structure adequately. There may be thousands of elements and many thousands of linear equations to solve. Apart from the formidable task of finding the solution to these equations, the definition of all of the input data to the computer and the presentation of the results to the engineer is an important issue. In the early days of finite element modelling, the engineers manually had to prepare large files with data for the computer and to study large piles of computer printouts. In modern finite element programs, such work is automated using graphical interfaces to the engineer.

At the Nordic Telescope Group, the finite element program *ALGOR* is used. The program has a well-developed graphical interface and is capable of calculating many features, such as deformations, stresses, eigenfrequencies, spectral responses and thermal performance. The program can handle thousands of elements of many different types and solve many thousands of simultaneous linear equations.

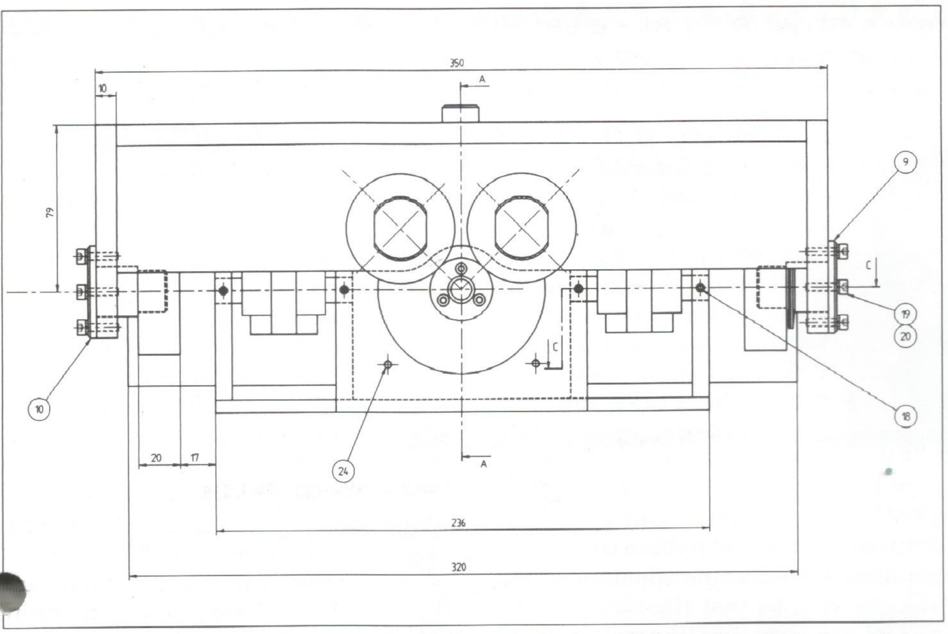
At the Telescope Group, the program is running on a 80486, 25 MHz computer with a 650 Mb hard disk. The program interfaces to other graphical systems such as AutoCAD and has special pre- and post-processors for data presentation. It takes 8-12 CPU hours to analyze large structures (7000-8000 equations), and temporary files may take up more than 400 Mbytes.

Examples of structures that have been analyzed at the Nordic Telescope Group using the finite element approach are: structure and mirrors of the Nordic Optical Telescope, LEST structures, LEST primary mirror and entrance window, ESO CAT tertiary mirror and the ESO VLT mirror cell.



An example of a finite element model. The cone for fixation of Cassegrain instrumentation and M3 pedestal to the ESO VLT cell is modelled as plate elements.

Nordic Telescope Group



An example of a drawing detail produced on AutoCAD. The drawing shows the new incremental encoder system for the Nordic Optical Telescope.

Computer Aided Design

Preben Ellebæk

Computer Aided Design (CAD) is used extensively at the Nordic Telescope Group. Compared to more conventional methods, this method has numerous advantages. Drawing precision and uniformity of the drawings are increased. Cost of design and preparation of documentation is reduced and it is possible to modify drawings much faster than before.

Preben Ellebæk

From the start of the design process, the drawings are in full scale. Complex drawing details can be inverted, scaled or rotated and different ideas can be studied quickly on the computer screen. Several designers may work on the same sub-assembly and yet be sure that their parts will fit together.

Furthermore, the use of *digital drawing catalogues* reduces the design time. Such catalogues replace normal documentation from the suppliers of machine elements, motors, etc. A drawing of a component from the catalogue and other relevant information appears directly on the computer screen and can be inserted into the drawing. Also, the digital catalogues may automatically assist in selection of components such that they fulfil specifications. For instance, a digital catalogue may assure that a proper coupling be chosen for a specific motor.

The Nordic Telescope Group has chosen the CAD system AutoCAD. This is the most widespread CAD system of the world and, thus, compatibility with other institutes and programs is ensured. We are presently in the process of updating the system to the new release 11 that also has the feature of solid modelling. As an add-on to AutoCAD, we are using the NETI-Norm S3 that has digital catalogues of screws, bolts, motors, ball guideways and other components.

The Telescope Group has three dedicated AutoCAD systems using Compaq 386 and 486, 25 MHz computers, 16" EIZO monitors and Calcomp digitizers. Also, AutoCAD is installed on two other computers that are used in parallel for other purposes. Plotting is performed on an A4 Canon laser-printer and a Roland A1 pen-plotter.

Optical Calculations

The following brief report is given by Kjetil Døhlen who served as optical engineer at the Telescope Group. Recently, Kjetil has left the group to obtain a doctor's degree at the Imperial College in London. He is now replaced by Mette Owner-Petersen, who has a background as assoc. prof. at the Technical University of Denmark. We are happy to welcome Mette to the crazy world of telescopes!

Kjetil Døhlen

Optical calculations are concerned with design of an optical system and its modification to fit mechancial restrictions, evaluation of the design, and calculation of its mechanical tolerances. All these tasks require tracing of large numbers of light rays through the system. Each ray tracing involves a series of lengthy calculations, and in the days before the computer, optical engineers had at their command an army of special secretaries called ray tracers. Understandably, optical engineers were among the first extensive users of automatic calculating machines, causing revolution in the field of optical design.

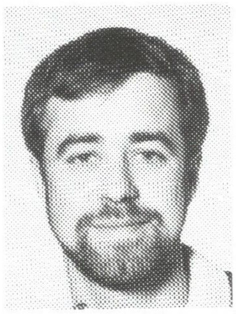
At NOT, we have used a programme called ICON, supplied by Norway Technology in Norway. Running on a 386-type computer, it performs hundreds of ray traces within a split second. The information is presented graphically in different forms familiar to the optical engineer, such as spot diagrammes and geometric encircled energy curves. The programme is also equipped with modules for optimization and diffraction calculations. The former is an important tool in the design phase of an optical system, the latter is required to give a true picture of the real-life performance of the system.

Engineering Tools used by the Nordic Telescope Group.................continued from page 8-9

Design of Electronics

Kim Stenberg

Electronics for telescopes and instruments are usually one-of-a-kind systems. For such systems, it is (from the point of view of economy and reliability) essential to apply commercially available units whenever possible. Anyway, it can not be avoided to design some printed circuit boards (PCB's) in-house. For this purpose, the Nordic Telescope Group applies the software package OrCAD.



Kim Stenberg

OrCAD has several modules. The design sequence usually starts with the SDTIII module, which is used to produce the schematic diagram. Afterwards, the output from the SDTIII module is used as input for both the PCB and the VST modules.

The PCB module is an efficient tool for transferring the schematic diagram to PCB layout. The output from the PCB module is either put on a floppy disk and mailed or transferred by modem to the manufacturer of the PCB.

Logic functions in digital electronics are efficiently implemented with programmable logic devices (PLD's). Programming of the PLD's are handled by the PLD module. This module enables the user to specify the logic functions in several ways, for instance by Boolean equations, indexed equations, state machine or truth tables. The output from the PLD module is used both when the PLD's are programmed and as input to the VST module.

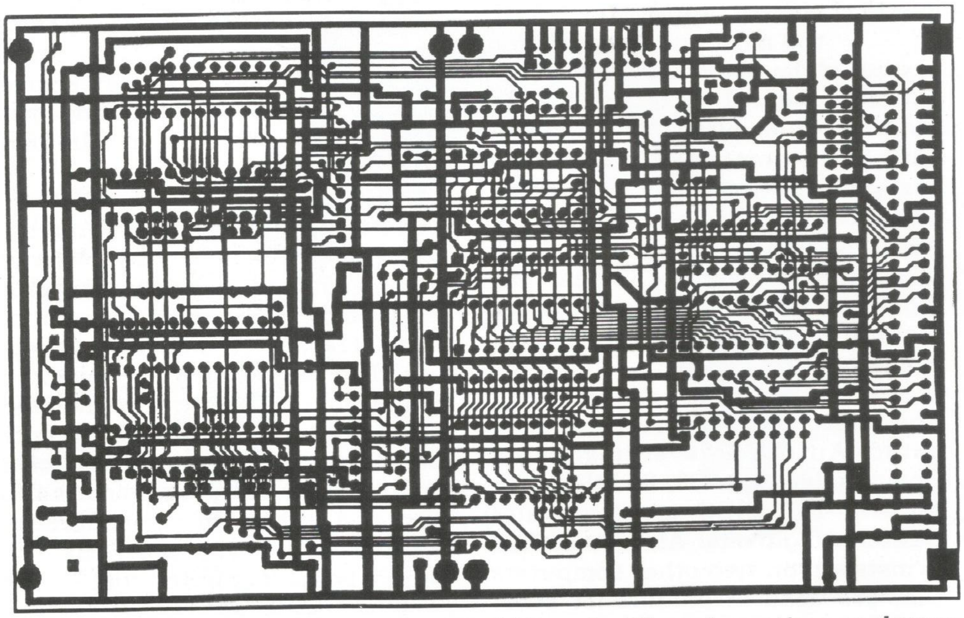
The VST module („Verification and Simulation Tool") enables the user to simulate even complex designs. Thus, we are able to test the design (produced with the SDTIII and PLD modules) before the PCB is manufactured. This feature is essential in reducing development time, since minor changes can be introduced and tested in a matter of minutes.

The designs produced with these tools usually do not require PCB revisions and can have a very short development time.

At the Nordic Telescope Group, OrCAD is presently running on a Victor AT computer with 30 Mb hard disk. This computer has rather limited capacity and it is planned to install OrCAD on a 386 computer within a not too distant future. Plotting is done on an HP Laserjet II and a Roland A1 pen-plotter.

It is interesting to study the lead times involved. The first PCB produced using OrCAD at the Telescope Group was assembled and tested in only four days. There were no errors in the printed circuit on the board. Subsequently, three other rather complex PCB's for the new computer system of the Nordic Telescope on La Palma were assembled and tested in totally only 7 days. Again, there were no errors in the printed circuit.

It may be concluded that the use of OrCAD as a tool for computer aided engineering has reduced the lead time for development of in-house PCB's and increased their reliability. Furthermore, OrCAD has proven to be simple and straightforward in use.



A PCB layout produced with OrCAD CAE tools. The schematic was drawn using SDTIII, logic designed with PLD and both verified with VST before the layout was produced with PCB.

Latest News on Telephones

Always eager for new endeavours and smashing actions, Spanish Telephone Authorities recently decided to change some telephone numbers at La Palma. Among the connections affected, we note the telephone number to the NOT and the telefax number to the Residencia. New numbers are:

NOT telephone connection:
+34 22 46 39 11

Residencia telefax connection:
+ 34 22 46 38 90

It goes without saying that, despite the new numbers, the telephone connection quality remains as high as ever.

Big Shots Reorganize

At their latest meeting in Oslo, Council, following up earlier discussions in Council and the STC, decided to reorganize the committee structure of the NOTSA. Considering the gradually higher emphasis on more purely scientific matters and the importance of best possible procedures for evaluation of proposals for observing programmes, Council found the time ripe to appoint a special Observing Programmes Committee (OPC). At the same time, it was decided to limit the Scientific Technical Committee (STC) to four persons.

The OPC will consist of one ordinary and one substitute member from each member country. Both the ordinary and the substitute members will receive proposals for observing programmes and be active in the evaluation work. However, only one member from each country will attend the meetings of the OPC. More detailed working rules for the OPC will be established at a later Council meeting.

At the Council meeting, it was felt that, with a total of eight committee members involved in the evaluation work, it should be possible to cover adequately most fields of observational astronomy which are and will, in the near future, be considered for programmes executed with the NOT. Bearing this in mind, Council elected for the OPC the following Nordic astronomers:

Ordinary Members:

Denmark:	Poul Erik Nissen
Finland:	Esko Valtaoja
Norway:	Rolf Stabell
Sweden:	Gösta Gahm

Substitute members:

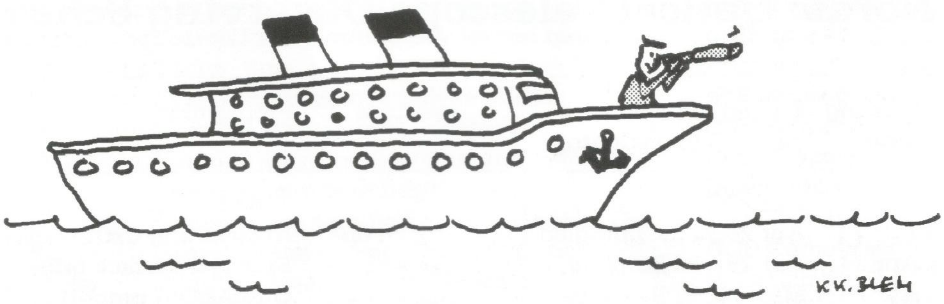
Denmark:	Jes Madsen
Finland:	Osmi Vilhu
Norway:	Jan Erik Solheim
Sweden:	Hans Rickman

The mandate period of OPC members was set to three years. As Chairperson of the OPC, Council appointed Esko Valtaoja and as Vice Chairperson Rolf Stabell. At the time of writing, most members had confirmed their participation.

For the STC, Council confirmed the membership of Steven Jörsäter, at the same time as it reelected, for a new term of three years, Bjørn Pettersen and Vilppu Piirola. As a new member of the STC, also for a period of three years, Council elected Johannes Andersen. Thus, the membership of the STC is the following:

Johannes Andersen
Steven Jörsäter
Bjørn Pettersen
Vilppu Piirola

Council appointed as Chairperson of the STC Johannes Andersen and as Vice Chairperson Steven Jörsäter. All of us would like to express our thanks to Vilppu Piirola for his years as knowledgeable and efficient chairperson and Tapio Korhonen as a Committee member with unusual insights not only in matters concerned with optical figuring.



.... more on Copenhagen Temptations

Following up the intentions referred to in NOT NEWS No. 2, planning for a Workshop on Astrophysics with the Nordic Optical Telescope have proceeded. Bernard Pagel has, with some support of the present editor, organized a programme to be launched at the NORDITA premises in central Copenhagen. Starting on Monday, April 8, and ending on Friday, April 12, the workshop is intended to expose the scientific achievements and possibilities of the NOT in an international context. Some of the topics include

- NOT and other telescopes at La Silla, La Palma as well as elsewhere
- Instrumentation and reduction facilities
- Samples of astrophysical results and programmes, mainly, but not exclusively, from Nordic observers
- Possible key programmes
- Remote observing

For those not getting a kick out of these topics, it may be reassuring to note that the workshop programme also includes a boat trip to Hven (weather permitting). In addition to the display of yesterday's frontier technology, hopes are that a historical lecture can be arranged. Plus the boat trip itself, and the island...

A promising number of high level astronomers and designers of telescopes and other instrumentation have announced their participation. Even our stressed Council has decided to attend and to attach their next meeting to the workshop activities. We look forward to a meeting marked by exciting contributions and discussions. Don't forget to book April 8 to 12.

The Lucky Ones

Both the first and the second allocation periods have been marked by heavy over-subscription, the observing time requested exceeding that available by a factor close to five. Although many astronomers might doubt it, nevertheless some have had reasonable luck. In order to prove the case, we show the attached table of allocations, details including principal investigators and their institutes, abbreviated descriptions of their programmes and the auxiliary instrumentation requested and used. We have included the periods used exclusively for technical work as well as for commissioning of instrumentation. Finally, we have included the time reserved for the Nordic Research Summer School.

Until more observing time has been scheduled and used, detailed analysis of trends seems premature. However, already now it is easy to note the high popularity of imaging programmes, often connected with ambitious photometric work. This is a tendency well in line with our attempt to maintain our telescope as one of high image quality. Later months have produced many nights of excellent images, unfortunately parallel with a considerable number of nights plagued by rather bad weather.

Statistical analysis pending, one might also make a short comment regarding national distribution of observing time. With the first allocation period, April to September 1990, largely a business of the Finnish, Swedish and Spanish observing mafia, the second period, October 1990 to March 1991 has seen a much better spread of observer nationalities.

Nordic Optical Telescope Observing Schedule Apr. 1990-Apr. 1991

Starting date	Ending date	Principal investigator	Institute	Programme	Instrument(s)
Apr 02	Apr 20			Techn. time	
Apr 20	Apr 24	P.O. Lindblad	Stockh obs	Nuclear and extranuclear activity in galaxies	CCD Camera
Apr 24	Apr 29	N. Bergvall	Upps obs	Blue low surface brightness galaxies	CCD Camera
Apr 29	May 02	H. Rickman	Upps obs	Outgassing properties of cometary nuclei	CCD Camera
May 02	May 04	L. Haikala	Helsinki obs	Herbig-Haro objects with bipolar outflows	CCD Camera
May 04	May 06	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
May 06	May 11	J. Huovelin	Helsinki obs	Surface-imaging of stars	Photopolarimeter
May 11	May 13			Techn. time	
May 13	May 20	O. Vilhu	Helsinki obs	UBVRI observations of X-ray binaries	Photopolarimeter
May 20	May 23	A. Sillanpää	Turku obs	UBVRI photopolarimetry of normal quasars	Photopolarimeter
May 23	May 26	K. Mattila	Helsinki obs	Extragalactic background light	CCD Camera
May 26	May 31	S. Larsson	Tromsø univ	Accretion-flows onto magnetic White Dwarfs	High-speed photom
May 31	Jun 01	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Jun 01	Jun 02			Techn. time	
Jun 02	Jun 08	I. Perez	IAC	Extragalactic jets/Quasars	CCD Camera
Jun 08	Jun 15	A. Mampaso	IAC	Central stars in nebulae	CCD Camera
Jun 15	Jun 18	I. Perez	IAC	Extragalactic jets/Quasars	CCD Camera
Jun 18	Jun 22	K. Mattila	Helsinki obs	Extragalactic background light	CCD Camera
Jun 22	Jun 26	E. Battaner	Granada	Warped discs	CCD Camera
Jun 26	Jun 27	I. Perez	IAC	Extragalactic jets/Quasars	CCD Camera
Jun 27	Jul 02	CI observers		CCI programme	CCD Camera
Jul 02	Jul 08			Techn. time	
Jul 08	Jul 14	Liseau/Kotilainen	Rome/Turku	HI line-emission/CO absorption	IR Spectrometer
Jul 14	Jul 19	J. Egonsson	Lund obs	Polarization in accretion disks	Photopolarimeter
Jul 19	Jul 23	J. Vernin	Nice obs	Atmospheric turbulence	Special
Jul 23	Jul 26	G. Gahm	Stockh obs	Star-formation at high gal lat	CCD Camera
Jul 26	Jul 30	M. Valtonen	Turku obs	X-ray selected active galaxies	CCD Camera
Jul 30	Aug 13			Techn. time	
Aug 13	Aug 14	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Aug 14	Aug 24			Summer school	Various
Aug 24	Aug 31	Pettersen/Korh.	Oslo/Turku	Stellar flares	Photopolarimeter
Aug 31	Sep 04	D. Kiselman	Upps obs	Circumstellar shells of carbon stars	CCD Camera
Sep 04	Sep 05	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Sep 05	Sep 12			Techn. time	
Sep 12	Sep 17	Fridlund/Liseau	ESA/Rome	Herbig-Haro objects	CCD Camera
Sep 17	Sep 23	Piirola/Nielsen	Helsi/Brorf	AM Her magnetic binaries/QSOS	Photopol/CCD

Nordic Optical Telescope Observing Schedule Apr. 1990-Apr. 1991 ...Continued

Starting date	Ending date	Principal investigator	Institute	Programme	Instrument(s)
Sep 23	Sep 26	H. Nørgaard	Copenhagen	Imaging of NGC 1275	CCD Camera
Sep 26	Sep 28	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Sep 28	Oct 01	Ø. Olsen	NOT	Gravitational lenses	CCD Camera
Oct 01	Oct 03	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Oct 03	Oct 10	B. Thomsen	Aarhus	Commissioning	Low-Res. Spectr.
Oct 10	Oct 14	G. Olofsson	Stockh obs	Installation	Focal-Plane Chopper
Oct 14	Oct 21	Roca Cortés	IAC	Astroseismology	Special equipm
Oct 21	Oct 27	L. Valtaoja	Turku obs	Wavelength- dependent pol. of blazars	Photopolarimeter
Oct 27	Oct 29	F. Grundahl Jensen	Aarhus obs	Variable stars in open clusters	CCD Camera
Oct 29	Nov 02	J. Huovelin	Helsinki obs	Photopol. monitoring of late-type dwarfs	Photopolarimeter
Nov 02	Nov 06			Techn. time	
Nov 06	Nov 10	R. Liseau	Rome	H I line emission from moving envelopes	IR Spectrometer
Nov 10	Nov 13	M. Valtonen	Turku obs	Wavelength Dependence of Polarization	Photopolarimeter
Nov 13	Nov 15	M. Valtonen	Turku obs	Optical Imaging Polarimetry of Active Gal.	CCD Camera
Nov 15	Nov 17	H. Rickman	Upps obs	A search for cometary activity in asteroids	CCD Camera
Nov 17	Nov 20	E. Valtaoja	Turku obs	Imaging of GPS Radio Sources	CCD Camera
Nov 20	Nov 25	V. Piirola/O. Vilhu	Helsinki obs	AM Her binaries/ROSAT survey	Photopolarimeter
Nov 25	Nov 28	R. Stabell	Oslo obs	Search for gravitationally lensed quasars	CCD Camera
Nov 28	Nov 30			Techn. time	
Nov 30	Dec 04	A. Herrero	IAC	IR spectroscopy of massive stars	IR Spectrometer
Dec 04	Dec 06	H. Kjeldsen	NOT	Variable stars in open clusters	CCD Camera
Dec 06	Dec 07	Kjeldsen/Grundahl	NOT/Aarhus	Variable stars in open clusters	CCD Camera
Dec 07	Dec 12	F. Garzon	IAC	IR-spectroscopy of bright stars	IR Spectrometer
Dec 12	Dec 15	M. Valtonen	Turku obs	Cones of Ionizing Radiation in Seyfert Gal.	CCD Camera
Dec 15	Dec 17	P. Lilje	NORDITA	Gravitational Lensing by Rich Clusters	CCD Camera
Dec 17	Dec 22	C.-I. Lagerkvist	Upps obs	Primitive Solar System Bodies	CCD Camera Part time
Dec 17	Dec 22	J. Egonsson	Lund obs	Chaotic and periodic var. in x-ray binaries	CCD Camera Part time
Dec 22	Dec 25	C.-I. Lagerkvist	Upps obs	Primitive Solar System Bodies	CCD Camera Part time
Dec 22	Dec 25	J. Egonsson	Lund obs	Chaotic and periodic var. in x-ray binaries	CCD Camera Part time
Dec 25	Dec 28	T. Liljeström	Helsinki obs	CCD imaging of water masers	CCD/IR Spectrom.
Dec 28	Jan 03	E. Pérez	IAC	Espectroscopia IR de galaxias	IR Spectrometer
Jan 03	Jan 05			Techn. time	
Jan 05	Jan 08	B.R. Pettersen	Oslo obs	Surface Phenomena of stars	Photopolarimeter
Jan 08	Jan 13	M. Kidger	IAC	Multifrequency observations of BL Lac obj.	Photopolarimeter
Jan 13	Jan 16	B. Pagel	NORDITA	The structure of HII galaxies	CCD Camera
Jan 16	Jan 20	J. Sommer-Larsen	Niels Bohr	Butcher-Oemler effect in low redshift clusters	CCD Camera
Jan 20	Jan 23	E. van Groningen	Upps obs	Observational test of the merger hypothesis	CCD Camera
Jan 23	Jan 31			Techn. time	
Jan 31	Feb 02	B. Thomsen	Aarhus obs	Commissioning	Low-res. spectr.
Feb 02	Feb 04	Kjeldsen/Grundahl	NOT/Aarhus	Variable stars in open clusters	CCD Camera
Feb 04	Feb 08	J. Antonio de Diego	IAC	Polarization obs. of „ordinary" quasars	Photopolarimeter
Feb 08	Feb 10	M.A.C. Perryman	ESA	Seeing improvem. and variab. studies	PCD
Feb 10	Feb 13	P.O. Lindblad	Stockh.obs	Nuclear and extranuc. activity in galaxies	Own + CCD
Feb 13	Feb 17	S. Jörsäter	ST- ECF	Deep surface photom. of spiral galaxies	Own
Feb 17	Feb 19	N. Bergvall	Upps obs	Blue low surface-brightness galaxies	CCD + Own
Feb 19	Feb 22	J. Hester	IPAC	Optical imagery of Supernova remnants	Own
Feb 22	Mar 04	L. Nordh	Stockh obs	Array imaging at 10μm and 3.5μm	Own
Mar 04	Mar 05			Techn. time	
Mar 05	Mar 10	I. Tuominen	Helsinki obs	Commissioning	High-res. spectr.
Mar 10	Mar 14	S. Larsson	Stockh obs	Pulsations in single and binary White Dwarfs	Photopolarimeter
Mar 14	Mar 18	B. Gustafsson	Upps obs	Galaxies in high redshift clusters	CCD Camera
Mar 18	Mar 22	T. Oja	Kvistab obs	UBVRI photometry at the North Galactic Pole	Photopolarimeter
Mar 22	Apr 03			Techn. time	

Co-Observers

Lars Olof Lodén

For budgetary reasons, night assistants in the traditional sense cannot be provided. The efforts to increase the minimal staff are entirely devoted to the technical part. While the need for more technicians is strong, that for night assistants is relatively modest. Because of the ingenious construction of the telescope and its auxiliary equipment, reasonably experienced observers may generally perform their observations without other support than the resident astronomers' introduction and stand by. Of course, it would be hypocrisy to allege that access to competent night assistants should have little or no importance for the outcome of the observing run. If the Nordic Telescope had been in the same favourable financial situation as some of its siblings, there should also be regular night assistants on duty all the time.

However, although NOT observers are generally capable of performing their observations more or less adequately themselves, they should not be completely alone at the telescope during an observing night. Therefore, the guest observers should make such arrangements that they are sure to have a „co-observer" designated before they go to La Palma for their observing run. In fact, the problem should be taken into consideration already at the writing of the observing time application. This has been pointed out in the instructions distributed to presumptive guest observers, and in most cases the visitors have solved the problem in various ways. Unfortunately, there have also been a few exceptions causing trouble for the local staff.

The need for what is called „co-observer" is essentially conditioned by safety reasons. The co-observer should therefore not be confused with night assistants or resident astronomers („support astronomers"). This means that the concept in question is not a unique one.

Species recommended as co-observers

In some cases there has been an agreement between one observer and his/her successor, so they both extend their sojourn over the two periods and support each other. This is a very good solution and the additional expense will be restricted to subsistence allowance for a few more days. In other cases a senior observer has invited one of his/her students to come along on the expedition and maybe to get the very first experience of observations with a big telescope. This is, of course, also a go[od] solution, although unavoidably it implies a doubled cost. A third way, that requires good planning in advance, is to let an observer with a first-part-of-night program share a period with another observer with a second-part-of-night program. They then stay together all the time at the telescope. A series of variations of that theme are then conceivable, but, for obviuys technical reasons, they cannot be materialized particularly frequently.

It has also occurred that someone from the local staff has taken the position as co-observer in accordance with a man-to-man agreement with the principal investigator. This, however, is not a good solution, unless the staff member in question is al[so] an established participant in the project. Otherwise there is a risk of circulation of the opinion among presumptive guest observers that „if we cannot find a co-observer of our own, we can always persuade a staff member". It is emphasiczed that this is a false opinion.

Sometimes it has been asserted that the demand for a safety arrangement of this kind should be relevant only during the „tough" period, when it is cold, foggy, icy, slippery, and windy. It is true that the risks are considerably increased during this period, and so are the consequences of an accident of any kind, but they are never that insignificant that we would recommend a guest observer to stay alone at the telescope, at least not during a whole night. In addition, the relatively „safe" period is surprisingly short - hardly longer than three months.

As the presence of the co-observers is basically an act of precaution, it is not completely indispensable for them to have observational experience or deep knowledge of astronomy, although it would help a lot. At a pinch, it may therefore be OK to have a girlfriend, a boyfriend, another friend, or a family member as co-observer at NOT. There will be no objection from the local staff against a solution of that kind. On the other hand, one may expect some reluctance from the research councils when the financial support is concerned. But, why not consider a minor contribution for this type of „unconventional“ solution of the safety problem if, for some reason, observers fail to arrange a „conventional“ one? It would be a rather cheap alternative, after all.

Computers Upgraded

Niklas Holsti

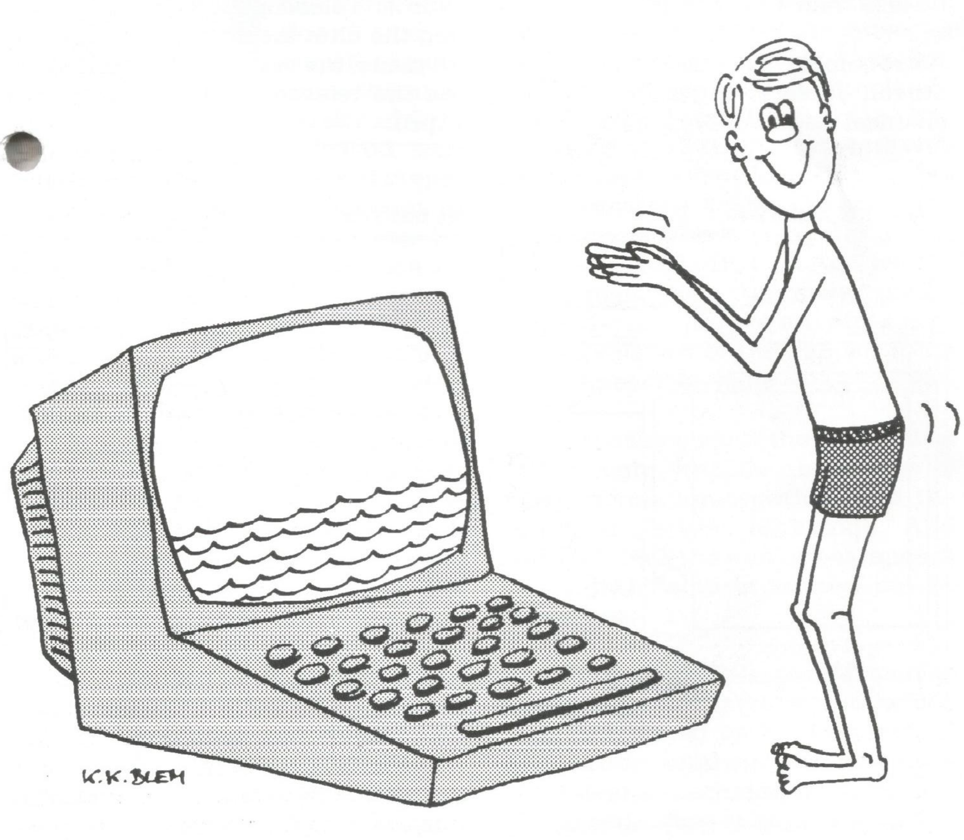
The NOT telescope control computer was replaced in August 1990 - just in time for the summer school. The new computer has three Motorola MC68030 processors - a master and two slaves, each with 4 Mb local memory. A VME bus connects the processors and the autoguider image processor. Optical fibers carry commands to VME I/O-buses in the electronics racks and on the instrument adapter.

The computer is fast enough for the rates required for NOT: a full coordinate transformation every 100 ms, with a position servo interval of 5 ms. The VME bus and optical remote I/O are far more reliable than the GPIB bus of the old computer. Program development is much easier: all processors are of the same type and run the same operating system (OS-9), addresses are 32 bits rather than 16; and programs are held on disk rather than EPROM.

The master processor programs - nearly pure Pascal - were ported by Niklas Holsti (NOT La Palma), and the slave processor programs - mainly Pascal, with some MC68000 assembly - by Ingvar Svärdh (NOT Risø). The crucial remote I/O system was made by Kim Stenberg (NOT Risø).

Program porting was not difficult. Minor problems arose in the areas: Pascal does not standardize multi-tasking, inter-program, communication and separate compilation.

The user interface of the control system is unchanged. The increased computer capacity allows new features - for example, it is now possible to integrate the guide TV image. Also, telescope and building acceleration are better controlled and the telescope now slews at the designed speed, some 2.5 degrees per second.



The computer and software are performing well and very reliably. Naturally, the first few weeks had their share of problems - we still remember the young astronomer who, at the start of the summer school session, promptly crashed the system by walking up to the terminal and pressing the MAIN MENU key... Such problems were eventually traced to an error in the delivered OS-9 configuration (conflicting interrupt vectors).

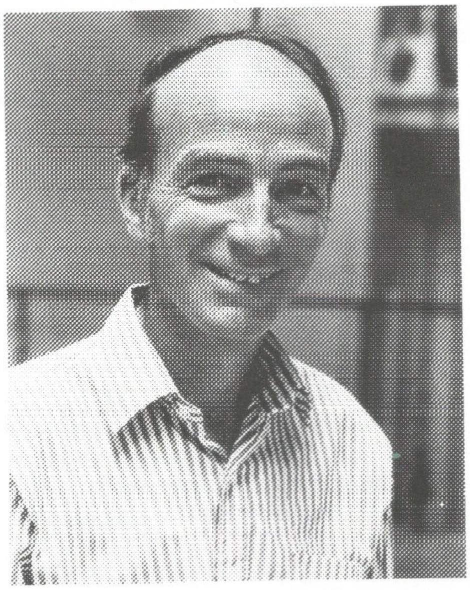
Work on the control system is now focussed on improving telescope tracking, where certain problems remain, although the noise level and stability of the Inductosyn encoder electronics have been improved markedly (work by Toomas Erm, NOT La Palma). Initial experiments with new friction-roller-coupled incremental encoders (from NOT Risø) were promising and we are developing procedures for combining the absolute (Inductosyn) and incremental encoder readings to eliminate their respective errors.

Per Olof hands over to Mats Ola

In the end, he just did it. Already when he accepted nomination as Chairperson of Council, Per Olof Lindblad clearly announced that this acceptance was for a year, not more. At the end of that year, he did exactly what we all had hoped he would not. He maintained his decision to leave as Chairperson. Worse still, he insisted on leaving the NOTSA Council altogether.

As one of those people making clear personal imprints on a worldwide scale, Per Olof has always been a busy scientist. Equally familiar with galaxies, their structure and dynamics as with international scientific organizations, he has continuously been a man of great influence, in research, observational and theoretical, as well as in research policy and administration.

We were lucky to have Per Olof as a member and Chairperson of Council.



P. O. Lindblad

We would have been even more lucky, had he accepted to stay on. He did not. And after all, it has to be admitted that he gave solid reasons. Said Per Olof: You see, I need to devote much more time for reduction and analysis of all those wonderful data obtained with the NOT.

Once Council had recovered from the firm decision of Per Olof, it proceeded to appoint a new chairperson. The choice went very smoothly, the convincing reasonably smoothly. In the end, Mats Ola Ottosson agreed to take up chairpersonship of Council. Like Per Olof, Mats Ola is a man of great involvement in and experience with international science. He will certainly steer our vessel with a firm hand.

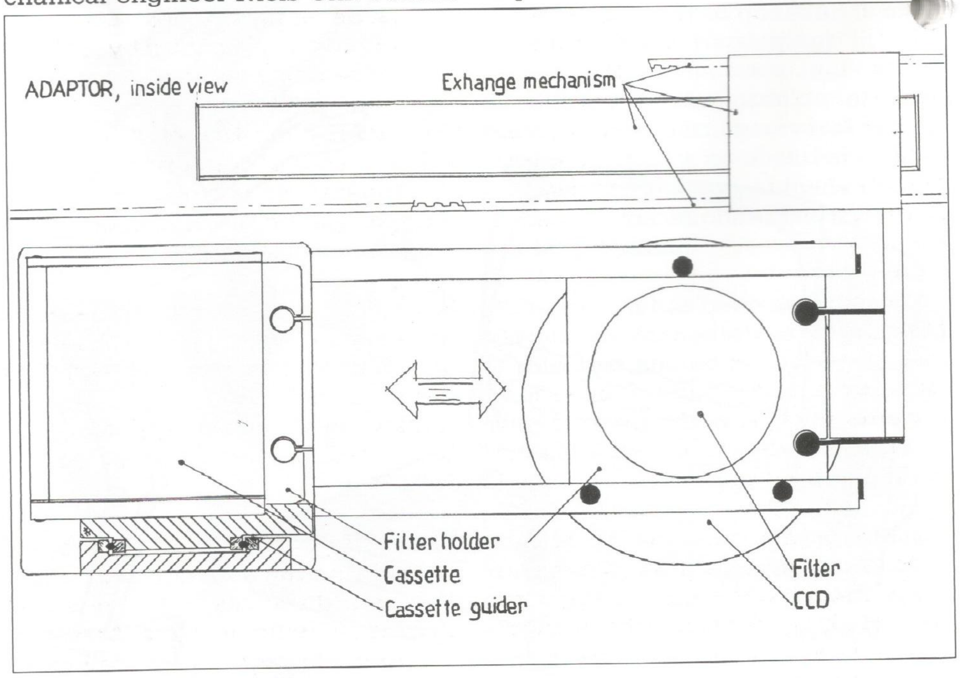
From the first of January 1991, the Council post left open by Per Olof Lindblad is taken over by Dainis Dravins. With his large experience, including sophisticated instrumentation, Dainis will be a true asset to the NOTSA.

CCD Filters

The Stockholm CCD Camera (described in NOT NEWS No. 1) has a filter wheel which is computer controlled. Presently, filters with a diameter of 25 mm can be housed in the filter wheel. It takes typically 15-30 minutes to fit new filters into the wheel or to exchange a complete filter wheel.

Increasingly, many astronomers would prefer to use larger filters. In practice, users often have filters of their own with larger dimensions. Therefore, a new filter mechanism permitting larger filters and quick changes is now being designed. The mechanism will have a cassette similar to those used on slide-projectors. It will be possible to exchange or insert new filters in a matter of seconds. Filters of any size up to 60 mm and a with a thickness of up to 15 mm will be applicable. Thicker filters may be accommodated if special measures are taken. Standard filter holders for filter dimensions 25, 50 and 60 mm will be available as a standard facility but alternative filter holders can easily be designed and manufactured. There will be room for 9 filters in each cassette. Exchange time between the various filters will be less than 10 seconds.

Astronomers Poul-Erik Nissen and Steven Jörsäter together with mechanical engineer Niels Chr. Jessen have specified the system. Franch Larsen, mechanical engineer of the Nordic Telescope Group, is designing the filter mechanism. According to plans, the system will be installed on the telescope before the end of April.



An early sketch of the new filter system design.


Students and teachers of Summer School outside the Residencia at Roque de los Muchachos

The NOT Summer School


Anlaug Djupvik

As I crossed Europe by the wings of IBERIA to participate in my first summer school in astronomy, being both excited and worried, I said to myself: coming from the university of Oslo you are going to be pleased anywhere, in spite of some lack of preparation due to the huge amount of literature which came too late. Finally I arrived at „the paradise island" as the last student, slightly embarrassed by coming one day too late and a little annoyed by the lack of a joint travelling arrangement for the Nordic students, the most natural and economic way, I thought. At the airport, however, sociable and cheerful Paco welcomed me and swung me gallantly past one picturesque scenery after another to the target of my voyage, where I was delivered in the middle of a lecture.

As time elapsed I met my fellow students and lecturers, who all amazed me with their open and friendly attitude. Had I arrived at another planet? And here at this altitude, having my head almost among the stars and touching the volcanic ground with my feet, I could not help thinking of other worlds. Feeling elevated by all this and the silence I was for a moment dangerously close to a religious dimension.

Being used to lectures packed with formulas and mathematics, with its own tendency to make the subject a little narrow and isolated, it was enriching to experience a completely visual presentation by one of the lecturers. Generally the topics were well presented and visualized by enthusiastic researchers who also attended each others classes, eagerly giving comments and remarks. And what a joy to meet them informally, giving us students what we are often missing, a relation of the subject to its widest possible angle.

The intensity level of the course was rather high, with its abundance of new information together with the practical part at nighttime. And frankly I think the non-appearance of the eighth lecturer turned out to benefit us.

The staff at the telescope deserves all credit for the patience with which they introduced us to the practical and instrumental matters. Any anxiety towards technical installations decreased substantially thanks to the relaxed and joyful atmosphere in the control room created by our guides there.

Perhaps I should also thank the impressive telescope itself for its facilities. The most exciting part was of course the practical experience with the telescope and its instruments in the attempts of making observations. The combination of theoretical lectures at daytime and direct action at night gave a good insight in the complexity of the art of observing. In my view it functioned well, but it might be that more time could have been given to collaboration work in observing and reducing the data at the cost of less time for lectures. In that case, however, the theory would have to be properly prepared in advance by literature available in good time.

All in all I regard the course as extremely valuable, and hereby I would like to thank the lecturers and the staff for the inspiration and the arranging committee for the good idea. Especially I would like to credit Jens Knude for his presence and participation and the ease with which he steered all practical problems away.

Finally, I hope that I some day will be able and permitted to come back to Roque de los Muchachos as a „grown-up" astronomer.

Tuorla Observatory

The new National Research Institute of Astronomy in Finland

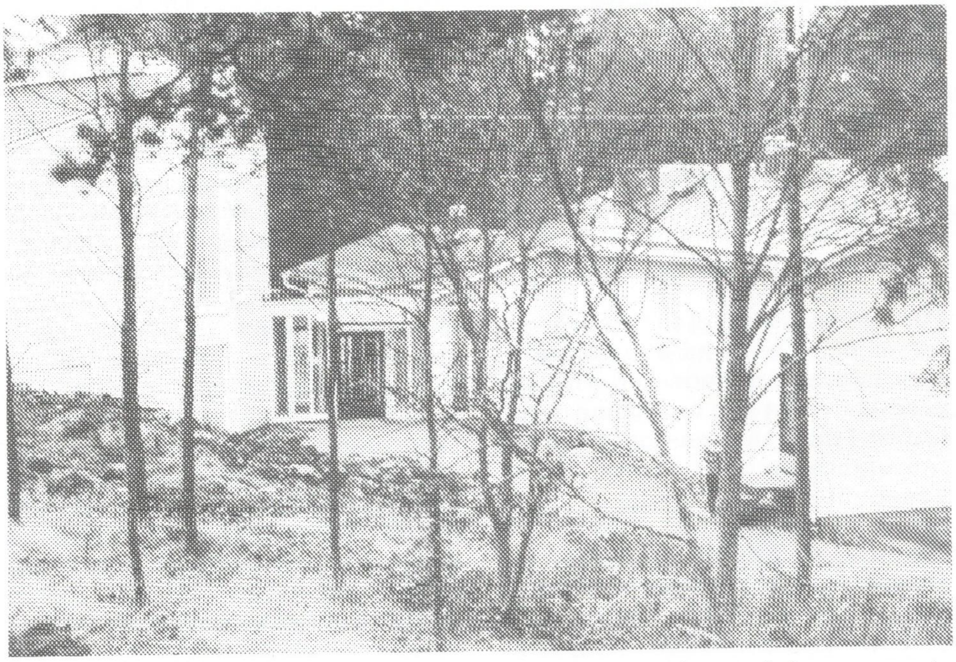
Mauri Valtonen

There has been a major reorganization and expansion of Finnish astronomy in connection with the Nordic Optical Telescope (NOT). A new research institute of astronomy has been created in order to support the research work with NOT and to provide the Finnish share of assistance to the operation of the telescope. The new institute will start operation officially on January 1, 1991.

Mauri Valtonen

The creation of the research institute is the culmination of a decade long effort to improve the material basis of Finnish astronomy. The current development began in 1980 in close connection with the NOT project. In that year two independent studies of Finnish astronomy and its development potential were carried out by the Finnish astronomical society and by the Academy of Finland, respectively. The former study pointed out the low level of funding of astronomy in Finland in comparison with other similar size countries in Europe. The latter study, headed by Prof. K. Mattila from the Observatory at the University of Helsinki, made some concrete recommendations. These have now been implemented to such a surprising degree that it is worth recalling the conclusions of his report.

The Mattila committee recommended that (1) Finland should take part in the NOT project as well as in the SEST project (SEST = Swedish ESO Sub-millimeter Telescope). It later turned out that there was not enough funding available in Finland for full participation in both projects. Therefore Finland accepted a 30 % share in the NOT, a share which is higher than what Finland would normally accept in common Nordic projects, and an arrangement was made between Finland and Sweden to exchange 5 % of the NOT observing share for 5 % of the SEST observing share. In this way the Finnish astronomers are now participating effectively in the use of both the NOT and the SEST.



Tuorla Observatory, the new National Research Institute of Astronomy in Finland.

The committee also recommended that (2) the domestic observatories should undergo a parallel strong development. In particular, the 14-m radio telescope of the Metsähovi observatory (belonging to the Technical University of Helsinki) and the Tuorla optical laboratory (of the University of Turku) were singled out. In both facilities strong developments have taken place in the 1980's. Metsähovi observatory has become an independent institute of the Technical University since then, under the direction of Prof. S. Urpo. The Metsähovi observatory is undergoing major developments in order to participate in VLBI observations on a regular basis and to participate in the international space VLBI project Radioastron. A major reconstructi[on] work was carried out in the underground optical laboratory in Tuorla, just in time so that the Tuorla observatory could accept to take up the grinding and polishing work of the optics of the NOT.

The committee recommended further that (3) Finland should become a member of the European Space Agency (ESA), which is indeed now happening. It proposed reserving fixed travel grants in order to support travel to foreign observatories, and funding of auxiliary instrumentation to support observations outside Finland. Much progress has also taken place in this area. It was suggested that the Academy of Finland should allocate an increasing number of its positions to astronomy and this h[as] also happened. However, the final recommendation of the committee, (4) the creation of the Finnish national research institute of astronomy, had not progressed any further when the 1980's were drawing to an end.

The manpower shortage in Finnish astronomy was brought to the attention of the Finnish Minister of Education, Christoffer Taxell, who reacted by setting up a new committee to study the situation. The committee was composed of the present and some former Finnish representatives in the NOT Council, the Chairman of the NOT Scientific-Technical Committee as well as administrative experts. The main recommendation of the committee was the creation of a new national research institute of astronomy at Tuorla belonging to the University of

Turku. The details of the plan were handed over to the Ministry of Education in March, the University of Turku approved the plan from its part in May, and the Minister of Education (now Ole Norrback) decided to create the institute in June 1990.

According to its terms of reference, the Tuorla Observatory is a national center of Finnish optical astronomy with a special responsibility for the Finnish part of the NOT project. The institute also carries out research in theoretical astronomy, radio astronomy and space astronomy and it is governed by a board of representatives from five different universities and organizations in Finland. Initially the institute is funded jointly by the Academy of Finland and the University of Turku, but it is planned that the operation will be transferred completely to the University of Turku by August 1995.

The staff of the institute consists of eight positions funded by the Academy of Finland (research professor, senior research fellow, two junior research fellows and four graduate students), six technical and office staff members transferred from the Physics Department of the University of Turku (observer, director of the optical laboratory, laboratory engineer, technician, librarian and secretary) and a new staff position belonging to the University of Turku (software scientist, to be located permanently at La Palma and with duties assigned by the NOT association). In addition, the astronomy teaching staff of the University of Turku (professor of astronomy, senior assistant and assistant) will carry out their research in the national observatory. There will also be a number of persons working at the Tuorla institute in less permanent positions so that the whole personnel will be around 25 persons.

Since the staff of the institute is made up of persons whose responsibilities already now are at least partly related to the NOT, the creation of the NOT-oriented institute should not draw resources away from other branches of astronomy. At the same time the institute forms a strong concentration of astronomers of various interests which should guarantee the maximal benefit of the Finnish 7.5 million FIM capital and 1.0 million FIM annual investment in the NOT project. We hope that the new organization will also be helpful in the routine running of the NOT.

Cooling down...

The Nordic Optical Telescope has a double cooling system. One system takes care of the cooling of various technical devices and the cooling jacket around the control room and other first-floor installations. The other system is used for air conditioning of the control and electronics rooms. Presently, there is no backup for the latter system. In the event of a possible malfunction of the cooling compressor, it will be difficult to keep the electronics (and astronomers) sufficiently cool. The complete telescope installation may get out of operation.

For this reason, a back-up cold-water generator will be installed within a couple of months. After this installation, the risk that the telescope will be down due to malfunction of the cooling system should be close to negligible.

At the same time, a system which prevents ice from building up on the fan coils on the false floor below the observing floor will be added. The heat exchanger next to the service building will be boosted to increase its capacity. Also the cooling capacity inside the dome will be increased by appending another fan-coil unit on top of the staircase. There will be a supply of cold water at 5°C for ancillary instrumentation connected to the telescope. Finally, a cooling device will be added with the purpose of cooling the primary mirror in day time.

Business News

Big blokes battle bravely. The astronomical world simply got too small for Tapio Korhonen and his team. Moreover, as many of us have known for a long time, Tapio always found the astronomy landscape a bit drab. Taking the consequences of these facts, Tapio recently joined jet-set society and got into commercial swinging.

Continuing their largely underground activities in Tuorla, outside Turku, they now turn to a wider market needing first-class optical elements. At the same time, Tapio does not forget his old friends entirely. As an example, he continues as a NOT collaborator and adviser, in parallel sharing his know-how with the LEST project. All of us wish Tapio and his team well-deserved success in addition to maintaining the hope that we will be able to draw on them also in the astronomical future. We are still waiting for the rating of Tapio K Ltd on the stock market.

Tapio Korhonen

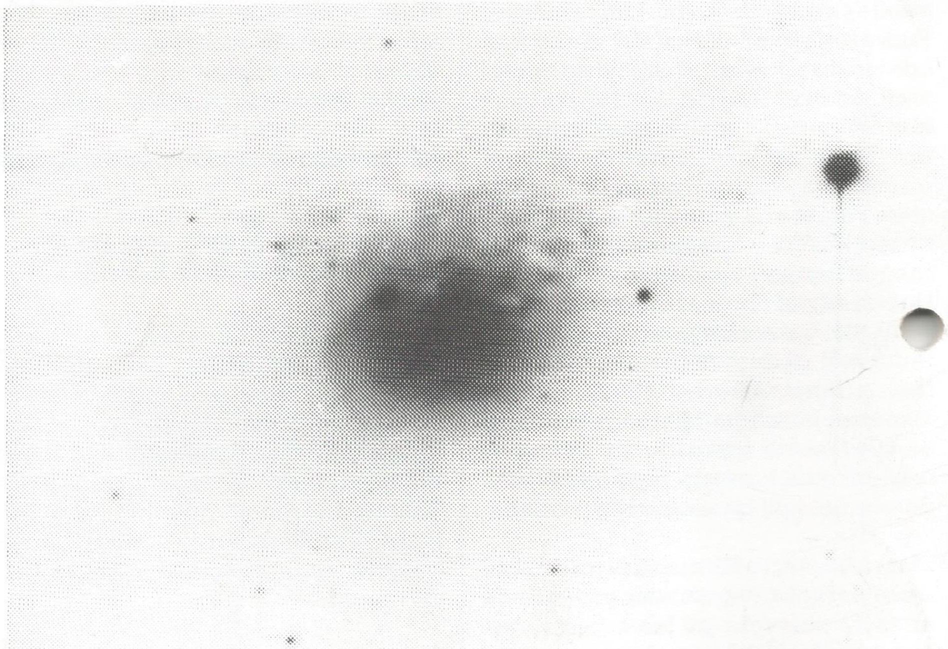
NOT Observes the Cooling Flow Galaxy, NGC 1275

Henning E. Jørgensen, Hans Ulrik Nørgaard-Nielsen and Leif Hansen

Ever since Minkowski in 1957 discovered two emission line systems, the Seyfert galaxy NGC 1275 has been studied intensively but nevertheless we are still far from understanding this dominant elliptical galaxy in the Perseus Cluster. Minkowski noticed a low velocity (LV) system at the redshift of the old stellar population (5200 km/sec) and a high velocity (HV) system (8200 km/sec) peaking North-West of the nucleus.

X-ray observations have revealed a relaxed low temperature (kT = 1 keV) gas component around the galaxy in the centre of the cluster. The widely accepted interpretation of the X-ray observations (like for other clusters) is that the Perseus cluster contains a cooling flow with a mass accretion rate onto NGC 1275 of around 300 M_o/yr. The LV system of filaments is then interpreted as condensations in the cooling flow since the cooling time is less than the Hubble time. The HV system could be a late-type galaxy superimposed by chance onto the central region of NGC 1275 and falling towards NGC 1275 with a velocity of 300 km/sec. The fate of the cooling flow material is not known but from our IUE observations it is recognized that star formation rates similar to the mass accretion rate as derived from the X-ray observations and with initial mass functions as in the Milky Way are excluded. However, our IUE observations show that some massive star formation is going on although at a low level.

A major source of uncertainty in the interpretation of the IUE observations is the lack of detailed knowledge of the surface brightness distribution of NGC 1275. Colours of absorption features and bright knots known from photographic plates must also be determined. We have therefore performed deep exposures on 3 nights in September in B, V and R as well as through narrow band filters to isolate the Hα emission from the high velocity in-falling galaxy. Although we were warned to use long exposure times as there was no experience from guiding of very long exposures, we obtained many frames with exposure times up to 1 hour. The results are very encouraging. Frames with up to 1/2 hour exposure time showed beautifully round images with FWHM for the seeing profile better than 0.8 arcsecond in many cases. Only some 1 hour exposures showed slightly elongated images, an effect which was corrected for on the last night by a software change. No doubt the quality of the telescope as well as of the autoguiding system can match the extremely good seeing conditions even in one hour exposures.



A NOT 30 minutes CCD exposure in the visual of the central elliptical galaxy NGC1275 in the Perseus cluster. The image is 100 arcseconds in the E-W direction. East is to the left and North is up. To avoid too strong gradients in the picture and to bring up the faint features we display here log (counts + constant). Notice the extended structures especially to the NW with many absorption features originating in the infalling galaxy.