

NOT NEWS

No. 1 *** December 1989

Nordic Optical Telescope Scientific Association

Our Telescope.....

The Nordic Optical Telescope has a 2.56 m primary mirror of Ritchey-Cr ethien type made of Zerodur and figured at the Tuorla Optical Laboratory, Finland. It has an aspect ratio of 1:13.5, a focal ratio of f/2.0 and is polished to an accuracy corresponding to 80 percent geometrical energy within 0.22 arc seconds in passive mode. The secondary mirror, also made of Zerodur and figured at Tuorla, has a diameter of 0.51 metres. The combined optical system gives, at the Cassegrain focus station, a focal ratio of f/11.0.

The mounting is of altazimuth type. Only a Cassegrain focus is available. However, the Cassegrain adapter carries a standby CCD camera which can, at any moment, be operational in a matter of seconds. In addition to the centrally mounted instrument and the standby CCD camera, further instrumentation can be maintained in stand-by function through optical fibre feeding via the adapter.

For ancillary instrumentation me-

Today's menu

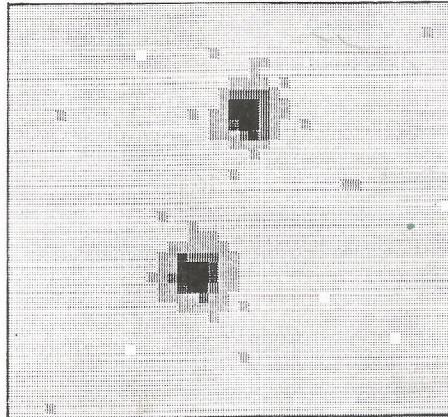
Taking your time page 5

*Friendly staff,
nice attention* page 5

Travel page 12

Outer space page 6

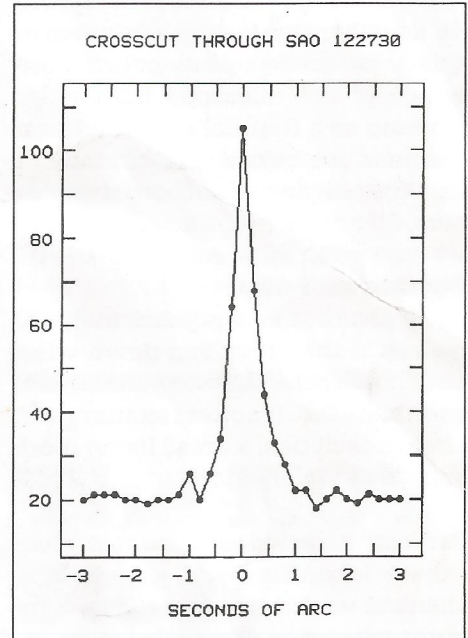
*Smoke signals -
best way for NOT
remote control?* page 12



Short exposure of SAO 122730, showing an image quality corresponding to FWHM=0.45 arcsec.

Star parade, sharp pictures

See page 2



Cut through image of SAO 122730

chanically attached to the Cassegrain focus station, the maximum free distance behind the adapter is 1500 millimetres and the corresponding maximum weight 250 kg.

A field rotator is integrated in the instrument adapter. The zenith singularity has a size of approximately 30 arc minutes times 20 arc minutes. For an object on the optical axis, dome vignetting affects a field of 1.3 degrees diameter centred on the zenith singularity. Limited by safety software in altitude, the sky available extends to -56 degrees in declination.

..... and its Building

For enhancement of image quality, the enclosure of the telescope has been minimized. For the same reason, the telescope has been elevated to have its primary mirror around nine metres above ground. The dome has a diameter of 11.1 metres and is void of installations producing heat. Except for the observing floor, the telescope building contains a ground

floor and a basement. The building corotates with the telescope.

Rooms for observing, electronics and support installations are housed in the ground floor. Thermal disturbances from these rooms are eliminated in three ways. First, the rooms are kept at constant temperature under air conditioning with excess heat being ducted away and transferred to a secondary cooling system with water as heat carrier. Via this system, excess heat is transported to a heat exchanger 80 metres from the telescope in the prevailing down-wind direction. Second, all rooms in the ground floor are heavily insulated. Third, they are completely enclosed in a cooling jacket, extending into a false floor between the ground floor and the observing floor. This false floor or heat trap has an interior height of 150 centimetres. The cooling jacket, including the heat trap, is equipped with a forceful air circulation system, providing an air flow of more than two cubic metres per second. The air

flowing through the cooling jacket is temperature controlled with a minimum temperature of -6°C .

The heat trap includes the telescope base, the hydraulic bearing and the lower part of the telescope structure. In addition to heat-transfer prevention, the cooling jacket serves to cool the observing floor.

As a further precaution against artificially produced turbulence, the entrance of the telescope building is working as a thermal sluice. It has a temperature below that of ambient air, thus preventing outflow of excess heat.

Downtown Activities

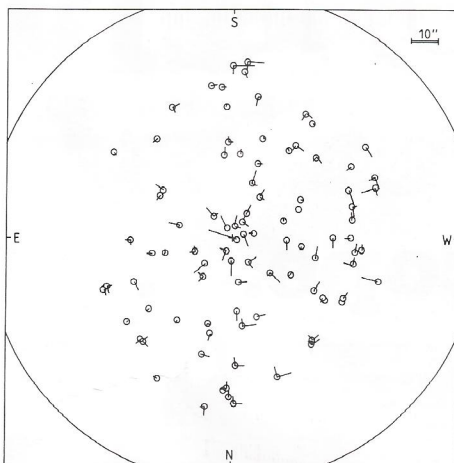
At a distance of approximately 90 metres in the prevailing down-wind direction, a small service building has been installed. It houses sanitary and kitchen facilities, a small living room and three small offices.

Further, it includes a modest electronics laboratory and a basic mechanical workshop. An off-line computer system is presently under installation. It is based on a Hewlett-Packard 835 computer. On this computer, we plan to install MIDAS under Unix.

Editorial

With the Nordic Optical Telescope now coming into scientific use, we plan to issue a semiregular news bulletin. We intend to publish typically two bulletins per year. It is hoped that they will serve as a medium for information and discussion concerning telescope, instrumentation, facilities and activities around the telescope. Readers are encouraged to forward contributions.

In this first issue, we concentrate on some basic information and short status reports. Forthcoming issues should report on development and activities defined by the operation phase now starting.



Recent pointing plot. Sizes and directions of deviations are given. The bar in the upper right-hand corner corresponds to 10 arcsec. Resulting pointing error is 3.5 arcsec rms.

Pointing along and tracking away

For blind pointing, specification of final accuracy has been set at two arc seconds. For the time being, this target value has still not been reached. Recent pointing tests show rather uniform results, giving an average blind pointing accuracy of around 3.5 arc seconds rms. Further work on pointing and pointing models is foreseen. We feel confident that the target pointing accuracy will be reached before long.

Regarding tracking, specifications state a final accuracy of one tenth of an arc second rms. For tracking without autoguider, such an accuracy cannot be achieved today. This is due to a number of factors. These factors have been traced and identified, and a work package is under way with the aim to reach target tracing accuracy without autoguider support. In the meantime, for observations requiring high tracking accuracy, the autoguider should be used.

Pictures of the Year

below 0.5 arc second

No systematic study of image quality has been attempted. Still, the experience obtained allows some general conclusions. These are based on exposures ranging from a few seconds to half an hour. For exposures exceeding a few minutes, autoguiding has been used. It is added, that our general experience of image

The Nordic Optical Telescope (NOT) Scientific Association was founded in 1984 to construct and operate a Nordic telescope for observations at optical and infrared 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 $17^{\circ} 52' 59.7''$ West, geographical latitude $28^{\circ} 45' 20.5''$ North, and altitude 2382 metres above sea level.

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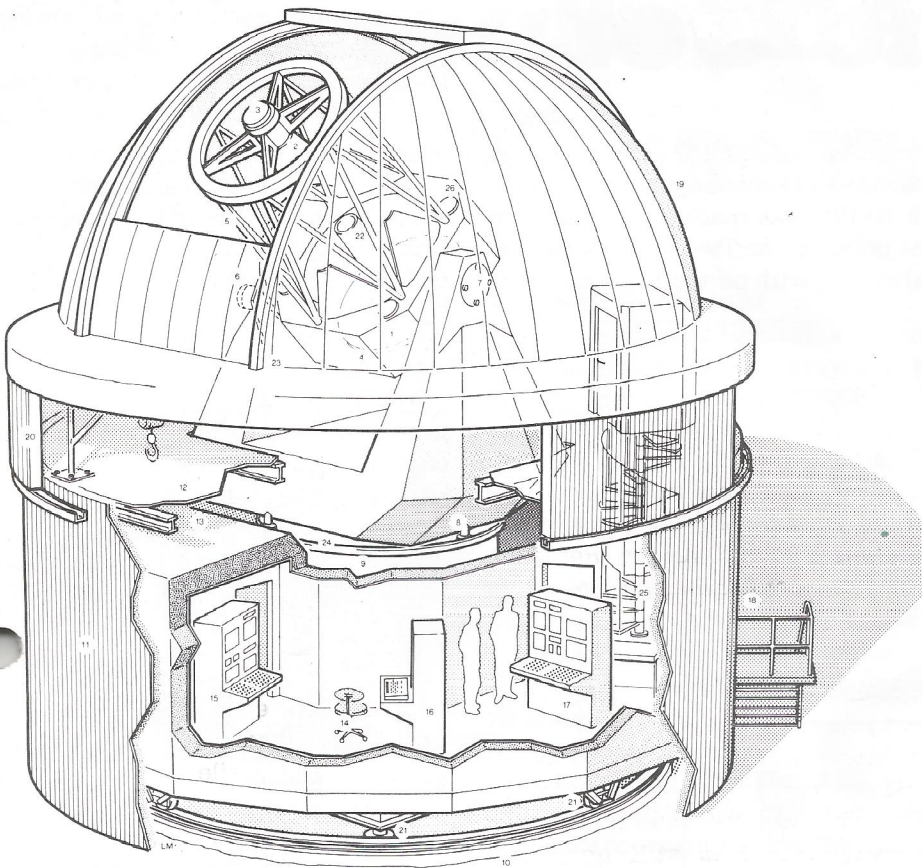
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Lay-out: Karsten Kofoed Blem.



Principles of the Nordic Optical Telescope showing main features of telescope, enclosure and control room.

quality mainly refers to the summer season.

First, our highest image quality recorded corresponds to 0.45 arc seconds rms. This is rather encouraging for a passive optical system, especially since alignment is only preliminary. We note, that the corresponding target value is 0.40 arc seconds.

Second, image qualities better than an arc second have been the rule with values between 0.6 and 0.8 arc seconds being rather frequent. Especially noting the fact, that thermal controls are partly still to be installed, this seems positive. There is every reason to assume that the site is of high quality in this respect, as also regarding extinction and transparency.

Getting in line

For control of the alignment of optical elements, a special optical system is available. It is based on spherical

surfaces on the primary and secondary mirrors and on an alignment detector in the adapter. An image analyzer of Hartmann-Korhonen type, now under construction, will be used to define transverse and angular positions of the secondary mirror as functions of altitude. Corresponding calibration relations will be stored and frequently updated.

What to do with all that light?

Four ancillary instruments have been installed and interfaced. A standby CCD camera and a polarimeter/photometer can be offered to visitors also without previous experience of these instruments. A highspeed photometer and a spectrometer for infrared wavelengths are both operational but still not ready for use by visitors without previous experience. Work is under way to improve the situation in this respect.

In this issue, short descriptions are given of the four pieces of ancillary instrumentation available.

..... and how?

Observing is, under normal circumstances, made from the observing room on the ground floor in the telescope building. Presence of observers on the observing floor is neither foreseen nor encouraged. In the observing room, telescope and ancillary instruments are operated via terminals. Continuous information is provided regarding status of telescope and instruments as well as concerning meteorological parameters.

Only limited basic catalogue material is available at the telescope. Thus, observers should be equipped with all observing material necessary for their programmes. We are trying to improve the situation in this respect.

The NOT Story

The Swedish video company Delta Media in Karlstad has produced a 55 minutes video film on the NOT. The video tells the story how the telescope was conceived, designed, constructed and erected. The film was shot on location during the various phases of the project. The film team from Delta Media did a hard job travelling to the many places in the Nordic countries and Spain where the telescope activities took place. Their work included helicopter filming on La Palma. The photographer was sitting in the open door of the aircraft with his legs free in the emptiness !

The film can be purchased at a price of SEK 450, from Delta Media, Box 5089, S-650 05 Karlstad, Sverige. There are presently two versions in Danish and Swedish, respectively. It is planned to add an English version.

The film has been produced with economical support from a number of companies participating in the project and from the Nordic Council of Ministers.

Scientific Corner

During testing of ancillary instrumentation, some limited data have been obtained of scientifically interesting objects. We give three examples of such data.

Simultaneous UBVR photometry of the AM Her type magnetic binary PG 1550+191 was made by Pirola with the polarimeter. Two successive orbital cycles, with period 113.6 minutes,

were covered. The optical variability is due to cyclotron emission from matter accreted near the magnetic poles of the white dwarf. The intensity of the cyclotron spectrum peaks

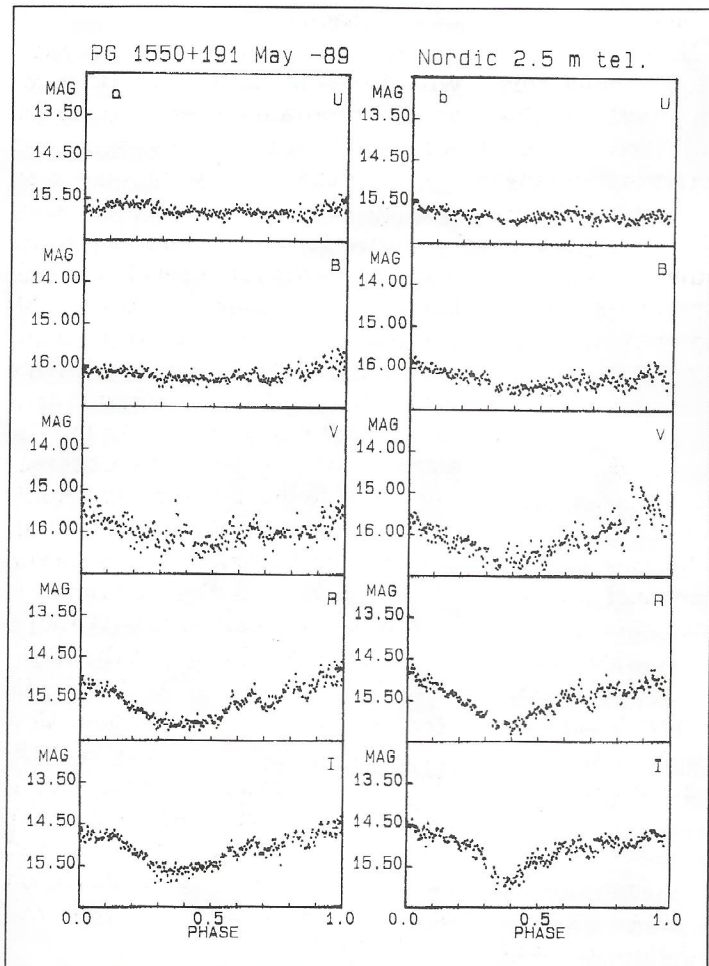


Fig. 1: Results of simultaneous UBVR photometry of the AM Her type magnetic binary PG 1550+191. The period is 113.6 minutes.

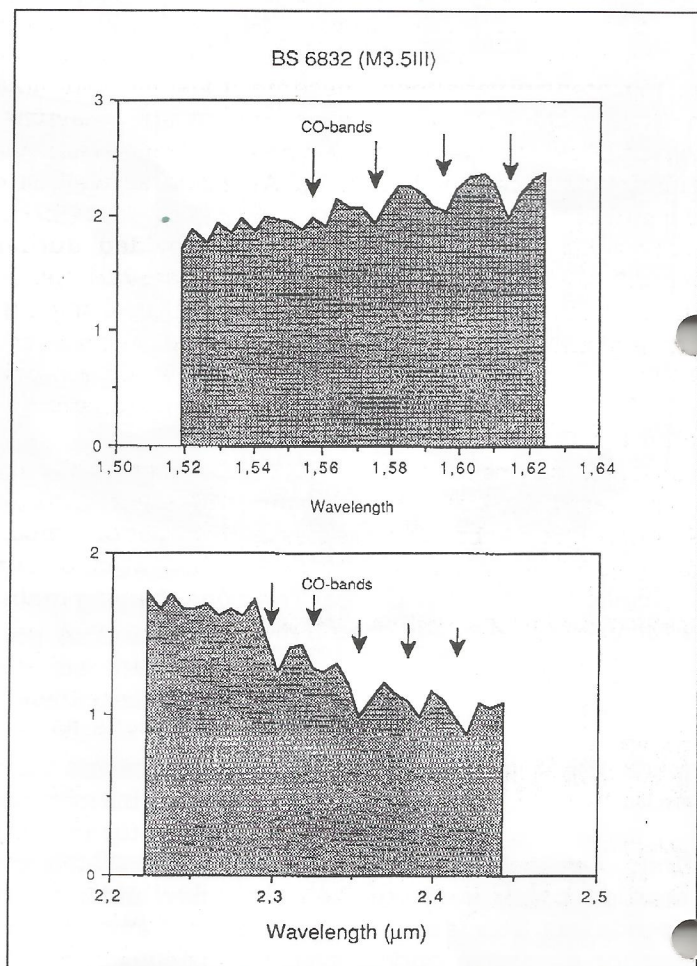


Fig. 3: IR spectrum of BS 6832 with a number of CO bands.

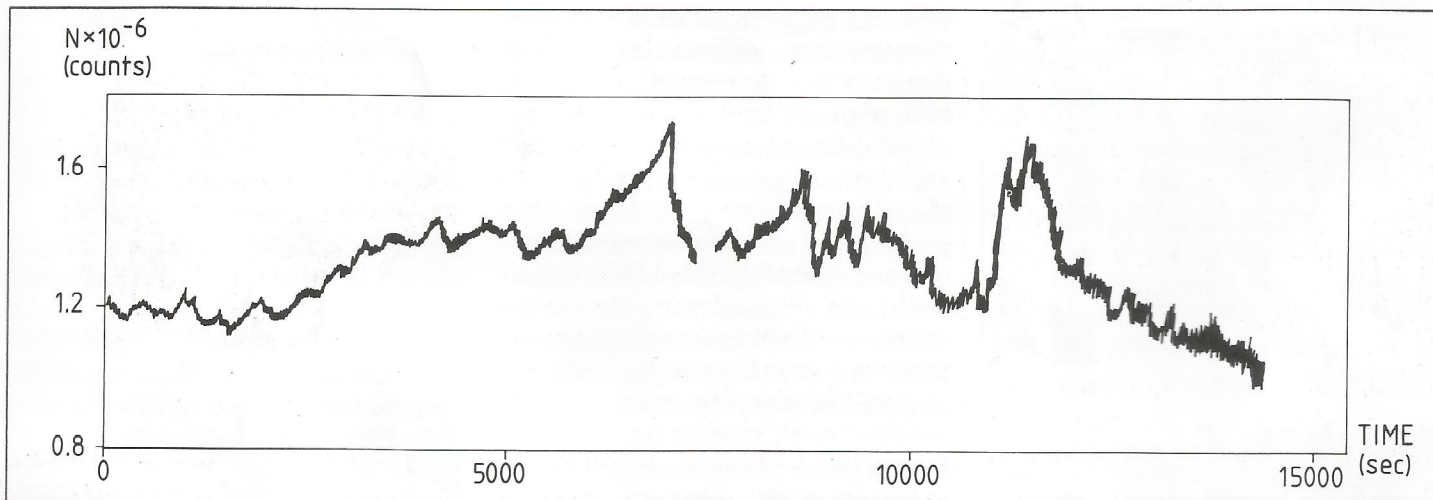


Fig. 2: Light curve of the pulsating white dwarf star G29-28 with several periods mutually interfering.

in the red and declines steeply towards the ultraviolet. The observations were made at nearly full Moon with sky chopping. Results are shown graphically in Figure 1.

Another light curve, of the pulsating white dwarf star G29-28, has been observed by Ulla and Solheim with the high-speed photometer. Periods of 615, 706, 820, 930 and 1020 seconds are present, and interference between these periods explains the strong intensity variations. These are obvious in the light curve, shown in Figure 2. The observations were made at large distance from the zenith. At the end of the observations, the star had a zenith distance of 71 degrees, which explains the strong noise at the end of the light curve. The star has a visual magnitude around $V = 13.1$.

With the IR spectrometer, Olofsson observed the spectrum of the M3.5 giant star BS 6832 from 1.5 to 2.5 μm . A number of CO bands were neatly displayed. This is shown in Figure 3.

New Gadgets

In addition to the four ancillary instruments now installed or under installation, some further instruments are under way. These include three spectrographs and one photometer. In collaboration with Norwegian colleagues, astronomers at Aarhus are completing a low resolution spectrograph for faint objects and a wide wavelength interval. A Boller and Chivens spectrograph for intermediate resolution is being rebuilt and modernized in Lund. Collaborating with Finnish astronomers, Russian colleagues are working on a spectrograph for high resolutions. A uvbyH β photometer is under completion in Lund. More information on these instruments will follow in coming issues.

On the Art of Observing

Who will do my Job?

Due to strict staff limitations, only basic support can be provided to visiting astronomers. Normally, this includes daytime introduction to the telescope and ancillary instrumentation as well as to control facilities. Further, night-time support will be provided during the first part of observations. Regular assistance during observing cannot be provided. Visitors are encouraged to overlap in time, thus providing mutual observing support.

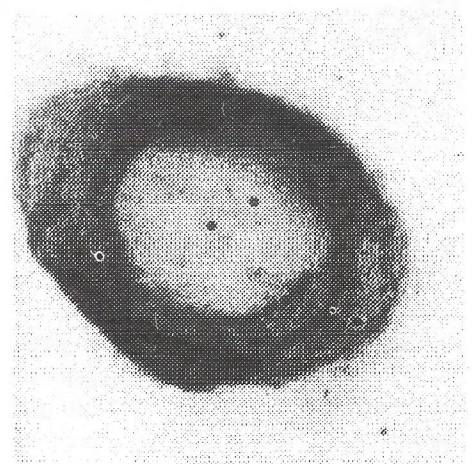
Those holding your Hand

Compared to those of other telescopes of comparable size, the operation staff of our telescope is very limited in number. In principle, it includes two astronomer positions, one position as software engineer, one as hardware engineer and part-time positions as mechanics technician and administrative assistant. In addition, two positions are available for students.

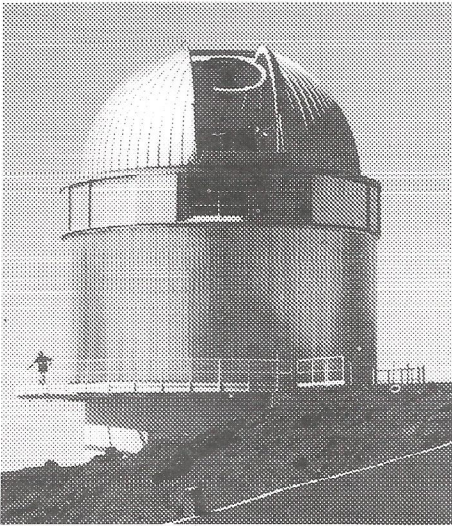
By the end of 1989, operation staff at Cruz del Fraile in practice includes four full-time and two half-time positions, with one of the full-time positions being shared by two staff members. Lars-Olof Lodén and Tarmo Oja share a position as senior astronomer, Niklas Holsti holds a position as software engineer and Toomas Erm one as hardware engineer. Leo Takalo has a position combining astronomy and software support. Peter Brandt and Francisco Armas hold half-time positions as mechanical technician and administrative assistant, respectively. Whilst Leo Takalo, regrettably, is due to leave our project within short, a position as staff astronomer is under appointment. Further, one of the student positions may be filled within the nearest months. It is added that the structure of operation staff is presently under study for possible revision.

..... and my Revolutionary Observations?

At the same time as technical work will proceed, observing time for science programmes will attain high weight. Up to now, observations have been performed only by local staff and by groups installing ancillary instrumentation. In January-April, some further observers will be called, having programmes suitable for the presently only two ancillary instruments duly installed. Jointly with this issue of NOT NEWS, a Call for Proposals is sent out. Responding to this, astronomers can apply for observations for the allocation period April-October. It seems safe to state that, disregarding unforeseen incidents, the CCD camera and the Polarimeter/Photometer will be available. We hope that the same will apply to the High-Speed Photometer and the IR Spectrometer. It is our hope, that around 60 percent of the time available can be used for science. Applications will be screened by the NOT Scientific-Technical Committee and priorities will be defined. Based on these priorities, observing time will be allotted.



Ring nebula, M57 (NGC 6720) from a 20 sec exposure in R. Image enhancement: Peter Linde, Lund Observatory.



Nordic Optical Telescope ready for observations as seen from the access road.

Niklas Holsti defends Thesis

That Niklas Holsti is a computer scientist of impressive qualifications has since long been obvious to anybody being in contact with his work. Now he has it explicitly on paper. On December 16, he defended his thesis in computer science in Helsinki, just in time for us to get the news into our paper. The title of the thesis is "Script Editing for Recovery and Reversal in Textual User Interfaces". Rumours has it, that messy astronomers have provided lots of case-study material. Anyhow, we congratulate Niklas.

Space Connections

In November, a team from ESA, Michael Perryman, Malcolm Fridlund, Bernard Debray and Sölve Andersson, visited Cruz del Fraile. The aim was to test the ESA Photon Counting Detector on our telescope. Due to limited technical problems in their electronics system, they did not reach this goal. However, they got some CCD images, that they found excellent. Being very satisfied with our telescope, they suggested further collaboration between the ESA and the NOT. From our side, we are very positive to this.

More Bedtime Reading

For more information on our telescope, reference may be made to the following articles:

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- Andersen, T.E. 1981: 2.5 m Telescope Design Study, Birkerød, Denmark*
- Andersen, T.E. 1982: 2.5 m Telescope, Addendum to Design Study, Birkerød, Denmark*
- Andersen, T.E. 1986: Mirror Cell Pressure Regulator, Technical Report from the Nordic Optical Telescope Scientific Association*
- Andersen, T.E., Jessen, N.C. 1985: Deformation Calculations of the Primary and Secondary Mirrors of the Nordic 2.5 m Optical Telescope, Technical Report from the Nordic Optical Telescope Scientific Association*
- Ardeberg, A. 1983: The Case for a 2.5 m Telescope, Proc. Nordic Astronomy Meeting in Oslo, Aug. 17, 1983, Inst. Theor. Astrophys. Blindern, Oslo, Report No. 60, p. 7*
- Ardeberg, A. 1984: Ancillary Optical Instrumentation - Provisions and Options, Proc. Nordic Astronomy Meeting, Sept. 3-5, 1984, Obs. and Astrophys. Lab. Univ. Helsinki, Report 6/84, p. 121*
- Ardeberg, A. 1985: Nordic Optical Telescope, Vistas in Astronomy 28, 561*
- Ardeberg, A. 1987: On the Nordic Optical Telescope, Observational Astrophysics, Methods and Techniques in Optical Astronomy, Proc. Nordic Research Course, Brorfelde, June 1-12, 1987, ed. R. Florentin Nielsen, p. 105*
- Ardeberg, A., Andersen, T. 1988: VLT Design Implications of the Nordic Optical Telescope, Proc. ESO Conf. on Very Large Telescopes and their Instrumentation, Garching, 21-24 March 1988, ed. M.-H. Ulrich, p. 183*
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- Florentin Nielsen, R. 1989: Cassegrain Adaptor for the Nordic 2.5 m Telescope, Technical Note from the Nordic Optical Telescope Scientific Association*
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- Jannerup, O. 1986: Design of Digital Main Servos for the Nordic 2.5 m Optical Telescope, Technical Report from the Nordic Optical Telescope Scientific Association*
- Korhonen, T. 1987: Optics for the Nordic Optical Telescope, Observational Astrophysics, Methods and Techniques in Optical Astronomy, Proc. Nordic Research Course, Brorfelde, June 1-12, 1987, ed. R. Florentin Nielsen, p. 198*
- Korhonen, T., Haarala, S., Piironen, J., Sillanpää, A. 1985: Manufacturing Optics for the Nordic 2.5 m Telescope, Departm. Phys. Sci. Univ. Turku, Report R 84*
- Laustsen, S., Klim, K. 1985: Telescope Pointing and Tracking, Technical Note from the Nordic Optical Telescope Scientific Association*
- Nordic Optical Telescope Scientific Association 1986: 2.5 m Telescope Assembly Drawings, Technical Report NOTSA*
- Nordic Optical Telescope Scientific Association 1986: 2.5 m Telescope Adaptor Assembly Drawings, Technical Report NOTSA*
- Olofsson, G. 1984: Do we need a Wobbling Secondary for NOT?, Proc. Nordic Astronomy Meeting, Sept. 3-5, 1984, Obs. and Astrophys. Lab. Univ. Helsinki Report 6/84, p. 171*
- Svärdh, I. 1989: User Manual for the Nordic 2.5 m Telescope Control System, Technical Report from the Nordic Optical Telescope Scientific Association*

The Tromsø High Speed Photometer

J.-E. Solheim

The photometer is designed for observations of two stars simultaneously. One star (object star) is observed with a photometer on the optical axis (main photometer). A second star can be observed with a photometer permanently mounted on the telescope adapter. The light to this photometer is picked up by an optical fibre which is located on the guide probe assembly in the adapter. If the autoguider is to be used simultaneously, a second star (guide star) has to be found in its field.

The purpose of the photometer is to observe a continuous light curve of a rapid variable star in the main photometer - and compare this with the light curve of a non-variable comparison star sampled identically through the optical fiber. In this way

it is possible to control atmospheric and instrumental variations which will give rise to false variability in the stellar light curve. When the photometer is fully operational, it will be possible to observe through 4 filters in rapid succession and get 4 light curves from each star. For rapid sampling, no filter changes are advisable.

At present, an uncooled blue-sensitive photomultiplier and UVB-filters are available in both photometers. When a cooling interface is available at the telescope, a red-sensitive photomultiplier will be mounted.

The photometer is controlled by a PC in the control room. The observed light curves are displayed on the computer screen in real time and stored on floppies. At present, the

computer cannot safely handle sampling rates shorter than 0.1 second and not change filters during an observation. A new version of the control program which may handle 4 filters and light curves is planned for March 1990. Further versions will sample as fast as 500 Hz.

At present, the light from the optical fibre comes out uncollimated, and very little reaches the fibre photometer head. A solution to this problem is under study.

The conclusion is that the photometer at present can only be used safely as a one-channel, blue-sensitive photometer, observing through one filter with sampling rates 10 Hz and slower. User manual for the photometer is now in the writing in Tromsø. It is expected to be available at Lund, Risø, Helsinki and Roque de los Muchachos in February 1990. Further information on the photometer and its progress can be obtained from Jan-Erik Solheim and Stefan Larsson, IMR, University of Tromsø (telephone +47 83 86060 or +47 83 44000, telefax +47 83 89852).

Stockholm CCD Camera

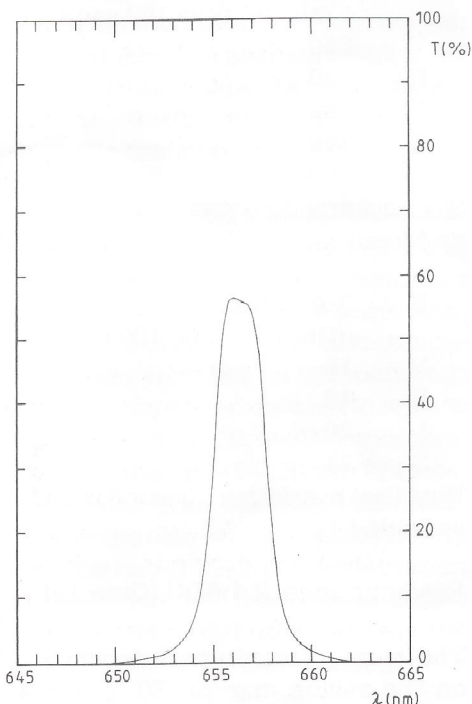
Göran Olofsson

The CCD Chip

We use a Tektronix TK512-011, "thick" frontside-illuminated CCD, which has virtually no UV response. Also, the over-all QE is lower than for some other devices. On the other hand it has a very low noise and it is cosmetically outstanding. This, combined with the excellent telescope and the site qualities and almost perfect filter performances give impressive images.

The Pixel Size and Polarimetry

In the normal position of the CCD camera - in the focal plane adaptor - the physical pixel size (27x27 microns) corresponds to 0.2x0.2 arcsec. This normally well matches the seeing, but for special needs a simple image scale converter is available which provides the options 0.1x0.1 arcsec., 0.2x0.2 arcsec. and 0.3x0.3 arcsec.

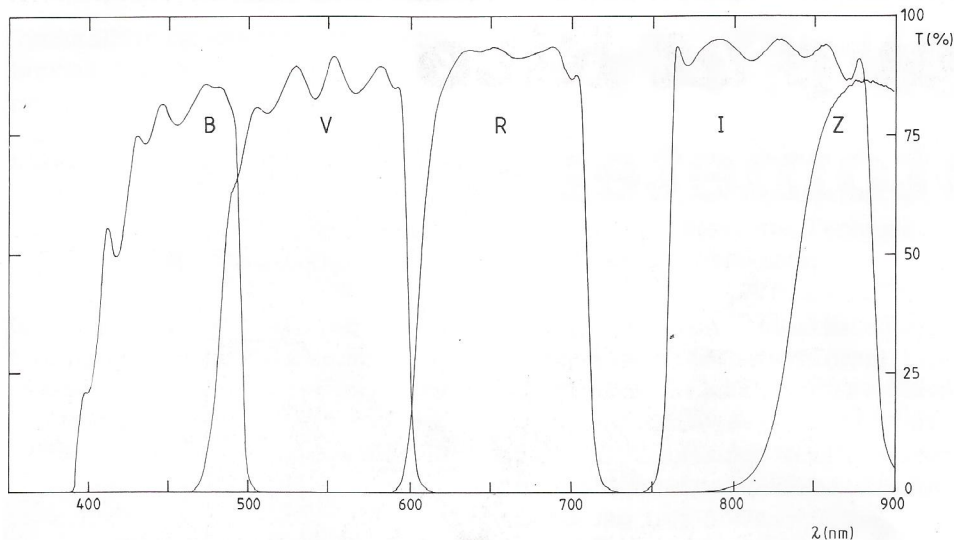


Transmission curve for the H α filter as obtained with our standby CCD camera.

This converter is also equipped with a polarizer for polarization observations of faint extended objects. The polarizer is remotely controlled but the filters in this converter have to be changed manually. I must stress that this converter has not yet been tested on NOT. On the other hand I am convinced that it will prove useful, and I would encourage any experienced observer with a suitable program to perform the testing and evaluation.

The Filters

In addition to the standard filters, a set of OIII-line filters are available (ten filters in the range 5010–5100 Å plus continuum filters at 4750 and 5150 Å). The width of the line filters is 20 Å and that of the continuum filters is 50 Å. The peak transmission is about 60%. Two filter wheels have been mechanically modified to host these (slightly too thick) filters. Note that it is not a trivial matter to change filter wheel! Once you know how to



Transmission curves for the B, V, R, I and Z filters, respectively, as obtained with our standby CCD camera. Note that the shape of the Z filter beyond 900 nm is, to a major part, defined by the detector and depends on temperature.

do, it will at least take 15 minutes to change wheel.

If you like to bring your own favourite filters, the mechanical constraints are the following: Diameter = 25 ± 0.2 mm (one inch filters normally don't fit!) Thickness ≤ 5 mm

The Computer System and the Software

Photometrics Ltd has provided a quite versatile camera system which includes many useful possibilities like pixel binning, zooming, statistical analysis, numerical cuts, photometry of stars, etc. This program package is well described in a Users Manual which will be copied and distributed to Nordic astronomical institutes by the end of January. Steven Jörsäter has extended this package, and the description of these extensions is presented on the screen when starting up the system.

The images are stored on standard magnetic tape (1600 bpi) in the FITS format. I would recommend anybody who is preparing CCD observations on NOT to check with the NOT staff if you need to bring your mag-tapes (generally flat-fielding etc. produces a lot of frames, why it is wise to be sure not to run out of storage capacity).

A quick Guide

Frame format: 500 px x 500 px (The chip format 512x512 is reduced for practical reasons)

Pixel size: 0.20 x 0.20 arcsec.

Spectral response: 400-950 nm

Filters (standard set): B, V, R, I, Z and H α

Conversion factor (gain 10): 1 ADU = 8.5 electrons

System response for a star with B=V=R=I=Z=20^m and zenith dist. = 20 deg.

B	260 ADU (Gain 10, time 100 sec.)
V	860
R	730
I	390
Z	245

Sky background (typical values with no Moon)

B	3 ADU/px (Gain 10, time 100 sec.)
V	16
R	18
I	30
Z	31

Note that the sky background is quite variable !

Read-out noise: 2.4 ADU (Gain 10)

The limiting magnitude is dependent on the seeing -e.g. for 50 % of the energy inside 1"x1" a S/N=3 is achieved in 10 minutes for a star with V=24^m.

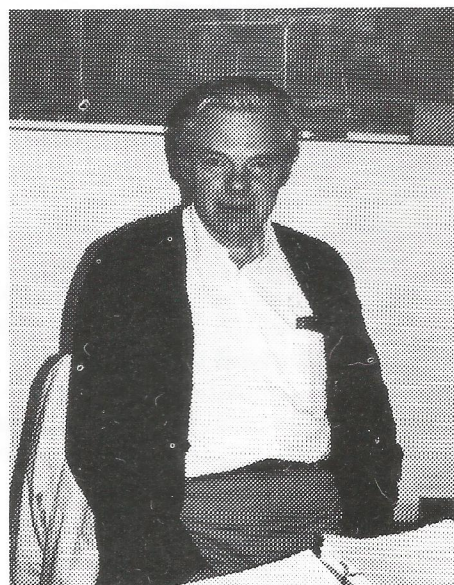
Svend steps down from his chair

When the Nordic Optical telescope Scientific Association was established, in January 1984, Svend Laustsen was elected Council Chairman. In this position, he was a prominent promotor for Nordic cooperation in astronomy. He discussed and negotiated, in the end always pushing solutions in the positive direction. Always true to his ideals, he steered our vessel in calm waters as well as through occasional small storms.

After the inauguration, he chaired another meeting of Council in Turku, on November 10, 1989. At the same time, he stepped down definitely. Those of us, who collaborated with Svend during these hectic years of telescope construction, can only thank him deeply for his devoted and skillful work. We will send him a Call for proposals...

Jointly with our Chairman, also the Vice-Chairman of Council took off. Leif Westgaard was one of the founders of NOTSA. He was also a very active member of Council, always contributing ideas in critical situations.

Sorry to miss Svend and Leif, we are most happy to see Per Olof Lindblad as new Chairman of Council. Also, we greet with great satisfaction Synnøve Irgens-Jensen as Vice Chairperson and Johannes Andersen as new member of Council.



Svend pondering on low-cost image quality

Design Group at Risø

Torben Andersen

The Nordic Telescope Group at Risø in Denmark presently counts 11 persons. Of these, 8 are engineers. According to a cooperation agreement, the Nordic group jointly works on NOT-related activities and on the design of the LEST (Large Earth-based Solar Telescope). About 75% of the time is spent on the design of the LEST, which will be the world's largest solar telescope. Other activities, related to the NOT, are described in the following.

The Tuning on La Palma

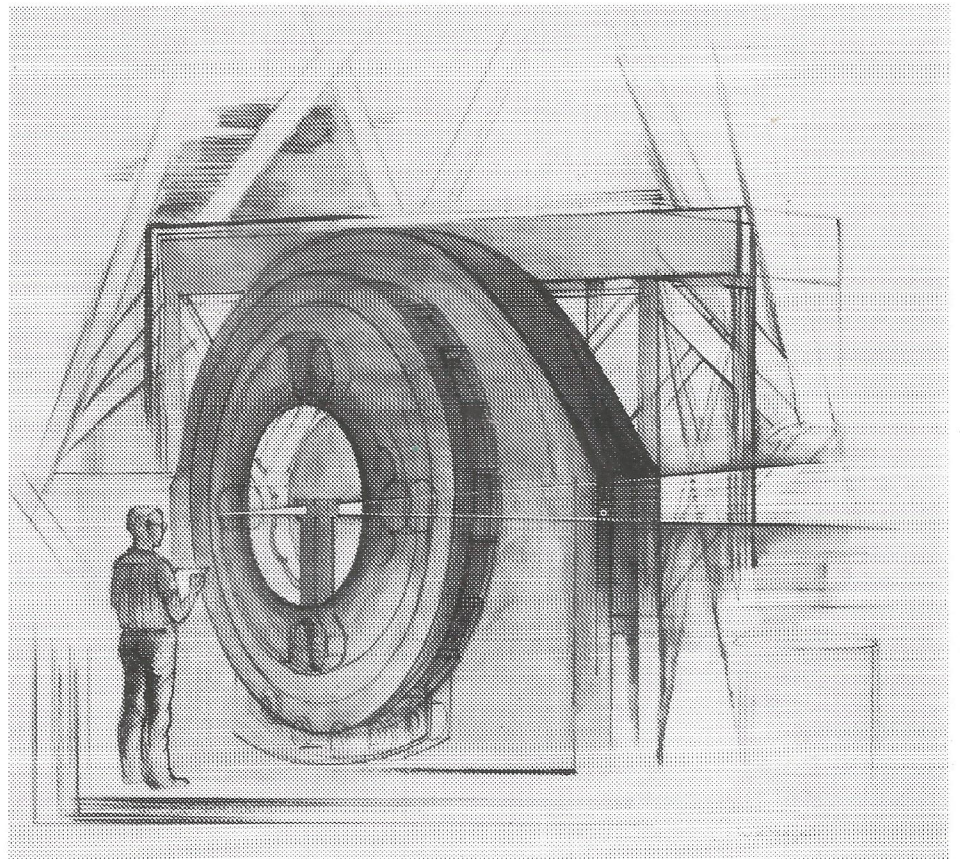
Operations staff on the 2.5 m telescope on La Palma has been very active in 1989 and has implemented numerous features on the telescope. In this connection, the technical group at Risø has given technical support to operations staff and has assisted in bringing various pieces of equipment into operation.

In the beginning of 1989, the Risø group has participated in the running-in of the adapter electronics. Also, a significant effort was made fighting electrical noise in the control system. Furthermore, the weather station was taken into operation after problems with lightning strokes.

By the end of 1989, various performance measurements were carried out. The eigenfrequency of the telescope foundation was measured to 8 Hz, a value better than specified. Also measurements of oil film stability in the hydraulic pads have been carried out.

The suspension of the main mirror in its cell turned out to have a poorly damped eigenfrequency of 11 Hz. Therefore, an active, electromechanical damping system was added. The sensitivity of the mirror to building vibration was thereby considerably reduced.

The electronic building servo system was optimized which increased the acceleration capability of the building servo. The maximum slewing velocity



Artist's impression of VLT Nasmyth adaptors. The mechanical design was made by the Nordic telescope group. Drawing: Mads Stage.

of the building is presently set to 2.6 degrees per second. This will eventually be increased to 4 degrees per second. Also the position loops of the telescope altitude and azimuth servos are presently being optimized to improve tracking.

New Design Activities

The Nord 100 control computer and its four Motorola 68000 companions are heavily loaded. At the same time, new more powerful low-cost computers have emerged on the market. It has therefore been decided to replace the Nord 100 and the 68000 microprocessors by a triple 68030 microprocessor system in a common VME rack. The upgrading will take place during the first half of 1990. Some adaptation of the software to the new computers will be required, but essentially the existing software can be used.

Mechanics for two incremental high-resolution encoders is presently being designed by the Risø group. The encoders will be installed on the

telescope in April.

The emergency closing system for the dome hatches that was supplied with the dome is very slow to operate. A more effective hydraulic system with a mobile gasoline motor will be designed and installed later in 1990.

ESO Activities

During the first half of 1989, the Nordic Telescope Group designed the mechanics of the VLT Nasmyth adaptors. Also, by the end of 1989, it was agreed that the Nordic group will design a new mirror 3 drive and suspension for an existing telescope in Chile (the "CAT").

Seminars

In connection with LEST activities, seminars have been held by Göran Scharmer (KVA solar telescope), Alain Tournaire (THEMIS), Richard B. Dunn (Sac Peak), Joachim Staiger and Dirk Soltau (VTT on Izaña) and Oscar von der Lühe (ETH) on telescope topics. More seminars are planned.

The Stockholm infrared Spectrometer (SIRS)

Göran Olofsson

Optical

Mounting: Ebert-Fastie (f/11, radius of curvature for the spherical mirror = 200 mm).

Grating: 300 grooves/mm

Blaze wavelength: 3.5 μm in the first order

Entrance slit: 1.5 arcsec (fixed)

Resolving power: See the Table below ($R = \lambda/\Delta\lambda$)

Filters: Order sorting filters are included

<u>Atm. window</u>	<u>R(N=1)</u>	<u>R(N=2)</u>	<u>R(N=3)</u>
J (1.25 μm)		(390)	640
H (1.65 μm)		550	
K (2.2 μm)	350	900	
L (3.5 μm)	600		
M (4.7 μm)	950		

Mechanical

Cooling: The spectrometer is cooled to 100 K by the first stage of a closed loop cryogenic refrigerator. The detector array is cooled to 40 K by the second stage of the refrigerator. Cool-down time is about 10 hours.

Wavelength tuning: The grating is rotated by a remotely controlled motor.

Filter selection: The filter wheel is rotated by a remotely controlled motor.

Electronics

Detector: A linear array with 32 InSb elements, pixel size 0.2x0.2 mm

(Cincinnati Electronics IMS-3201).

Read-out electronics: A new design with double-sampling to minimize drift (low frequency) problems (ACR Electronics).

Computer: IBM-PC/AT (compatible).

Software

House-keeping: The filter wavelength, the grating position and the detector temperature are calculated and displayed.

Test programs: A large number of test programs have been included (communication tests, source peak-up tests, noise tests etc.).

Observation programs: The running mean spectrum and the rms noise are displayed during the exposure. The DC-offset (including a substantial fixed-pattern "noise") plus the sky background are subtracted.

Manipulations: The spectral scans can be "flat-fielded" etc. by means of a special set of commands.

Manual: A full description has been written (by Ulf Mejerfalk). The text part of this will be distributed in February/March 1990.

Sensitivity

Conversion factor: 1 ADU = 300 electrons

Dynamic range (zero bias): 22 000 ADU

Read-out noise: 45 ADU rms

Maximum integration time (on chip)

The following table should be used as a guide-line:

	<u>time</u>
1 - 2.3 μm	4 min
2.4	2
2.8	1
2.9	16 sec
3.1	8
3.3	4
3.5	2
3.8	1
4.1	0.5
4.7	0.25

Limiting magnitude: The numbers above combined with a total estimated throughput indicate $S/N = 10$ at 2.2 μm for 15 min observation (including the background measurement) of a $K = 10^m$ star. This estimate has to be checked in practice.

Cool and Handy

Auxiliary instruments may most conveniently be shipped to La Palma by normal air freight. Shipments should be addressed to Grupo Nordico del Observatorio del Roque de los Muchachos, Apartado de Correos 474, E-38700 Santa Cruz de La Palma, Islas Canarias, Spain. It may be wise to reserve 1 - 2 weeks for customs clearance and handling. Transport of goods from the airport to the observatory can be arranged by Francisco Armas at NOT, La Palma. Francisco Armas may also provide more information on customs formalities.

Equipment may be lifted directly from vehicles outside the telescope building to the observing floor, at a height of around 6 metres, by means

of a 500 kp cantilever crane. Inside the observing room, instruments can be lifted and transported by means of two fork lifts on wheels.

A set of cables with standard connectors are being prepared for the users to connect instruments on the telescope with electronics in the control room. Furthermore, there are cable ducts connecting the observing room with the control room and the electronics room.

Within the first half of 1990, there should be a cooling water system available for auxiliary instrumentation. The capacity will be about 2 kW and the cooling water temperature 5 - 10 degrees C.

Comments

The system was installed at NOT in May 1989 and test observations were made. The spectrometer appeared to function well, but because of telescope problems it was only possible to observe bright stars. The quality of these spectra is not quite satisfying and we suspect that the poor telescope guiding was the main reason. Still, some of the spectra look quite nice. Now that the tracking of the telescope is working we hope to be able to prove the performance of SIRS and get this instrument commissioned for guest observers. A preliminary evaluation should be available by the end of February 1990.

Money, money

There can be little doubt that spectroscopy will be an essential part of our observing activity. Development of spectroscopic instrumentation is a challenging task but also something needing considerable amounts of money. Fully aware of this, Anders Reiz has convinced the VELUX foundation in Copenhagen to grant the amount of DKK 1,537,000 for development of spectroscopic facilities. Development work will be made by our telescope group at Risø.

UBVRI Photopolarimeter

V. Pirola

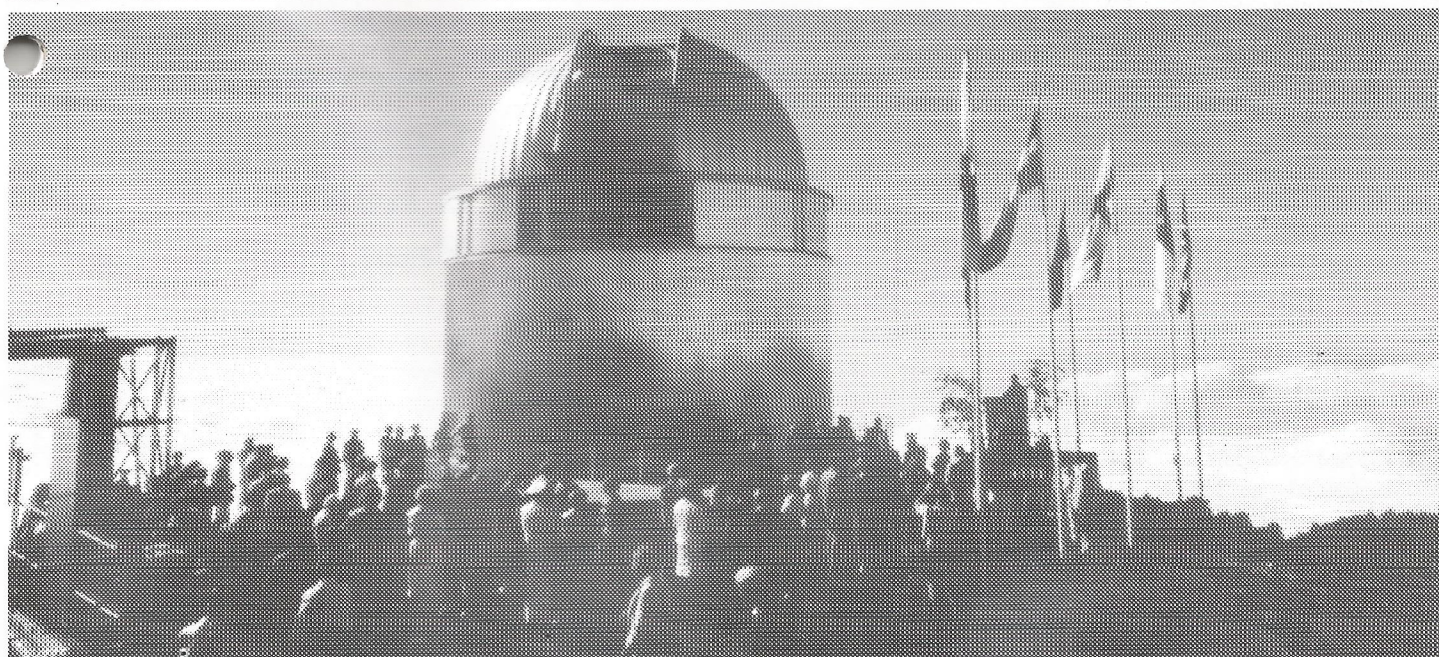
The instrument is a new version of the Simultaneous five-colour (UBVRI) polarimeter developed by Pirola in Helsinki in the 70's and extensively used for studies of interacting binaries and circumstellar matter since 1981 at Crimea and at La Silla. The double image chopping measuring technique provides inherently very good stability and enables polarization levels below 0.01 percent to be detected.

The colour bands are separated by dichroic filters which reflect the desired spectral interval and transmit the other wavelengths. Using four of such selective beam splitters, the light is directed into five photomultipliers for simultaneous recording in the UBVRI bands. The efficiency is high as there is practically no internal absorption in the dichroic filters. The design goal has been a good throughput and the instrument has been optimized for observations of faint and rapidly variable objects.

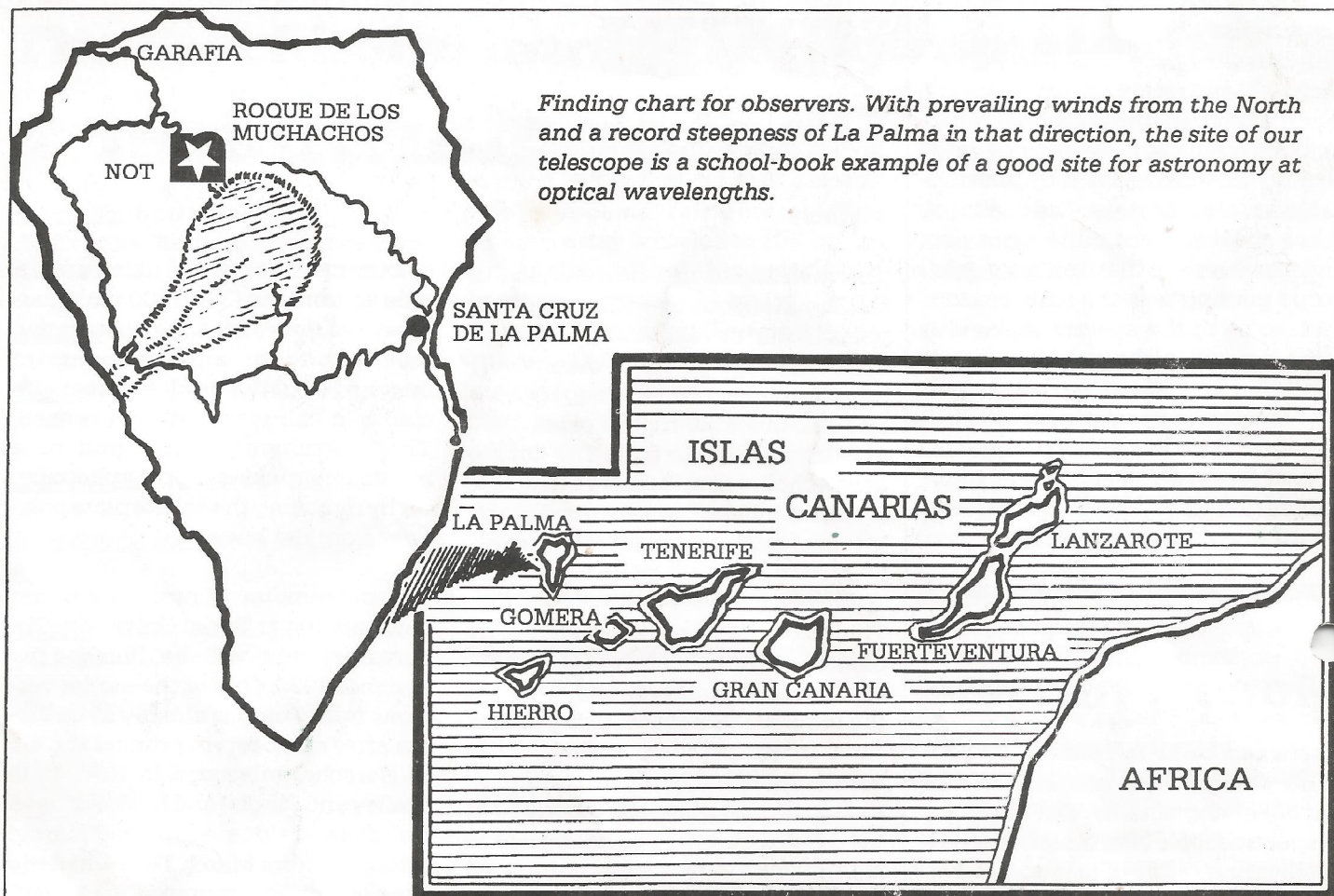
Simultaneous measurements of both circular and linear polarization in five

colours can be obtained using a rotatable achromatic (300-1100 nm) quarter-wave retarder as the polarization modulator. For measurements of linear polarization with the best efficiency, a half-wave retarder is used. The instrument is changed to a multichannel sky-chopping photometer by removing the calcite plate polarizer from the beam.

The polarimeter is presently under construction at Turku University Observatory and will be finished by summer 1990. One of the earlier versions from Turku is already at La Palma after an observing run on the 4.2 m Herschel telescope in Nov. 1988 (Bailey and Pirola) and has been used for observations with the Nordic telescope from March 1989 when the first scientific programs with NOT were carried out. Objects such as highly magnetic white dwarf binaries, rapidly rotating active stars, and quasars, have been monitored during the commissioning runs in the summer and the autumn.



170 critical observers making simultaneous V-band, multichannel imaging of NOT essential features at the inauguration on Sept. 8, 1989. The Director, Arne Ardeberg, enjoys birthday disk unit for NOT handed over by Carl Nordling, representing godparents.



Finding chart for observers. With prevailing winds from the North and a record steepness of La Palma in that direction, the site of our telescope is a school-book example of a good site for astronomy at optical wavelengths.

Getting to the Sun, looking at the Stars

La Palma can be reached from continental Europe by air and sea. Convenient and economic charter connections to Gran Canaria and Tenerife are available from major airports in Europe. A few charter connections include La Palma as end station. In addition, IBERIA operates frequent flights between Madrid, Gran Canaria and Tenerife. Local flights connect La Palma with both Gran Canaria and Tenerife. From Nordic airports, good alternatives are charter flights to Gran Canaria or Tenerife plus local flights to La Palma, and apex flights to the same places. Often, it is necessary to stay overnight in one of the connection points. Lowpriced hotels are available in Santa Cruz de La Palma, Santa Cruz de Tenerife and Las Palmas de Gran Canaria, reasonably priced ones in Madrid. It is advisable to reserve travel and accommodation well in advance.

No regular transports are available between Santa Cruz de La Palma and

the Roque de los Muchachos observatory. The distance between these points, approximately 40 kilometres, is covered by an asphalt road of good quality but rich in curves. A taxi should, by the end of 1989, cost less than 5000 pesetas, whilst a rental car can be hired for between 2000 and 3000 pesetas per day. Normally, transport with NOT cars cannot be provided.

Arrangements of taxi and/or rental car can be made prior to departure through contact with Francisco Armas, who is fluent in English (and Spanish). He can be reached through the NOT at La Palma as well as through his private telephone, +34 22 416123.

At the Roque de los Muchachos observatory, accommodation is provided in the Hotel Residencia. Accommodation includes room and full board at a price of presently 8000 pesetas per day. Timely reservation is advisable, either directly or via

Francisco Armas. The Residencia has telephone connection +34 22 400196, and English as well as Spanish is spoken.

Telephone Connections a Remote Facility

La Palma and the other Canary Islands have many attractive features. However, it takes an effort to include telephone connections among those features. It may be more correct to compare telephone quality to that of high-voltage supply on La Palma. At any rate, telephone connections have definitely constituted an impossible obstacle for our development of routines for remote control. Meanwhile, we can only admire Palmeros obviously putting up with their telephones.