

First Fully Automatic Telescope on La Silla

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The Danish 50-cm telescope on La Silla can now do the observing all by itself for many hours, while the observer visits the kitchen or library; or maybe uses another telescope. This is accomplished by having a single computer set the telescope, centre on a star, manipulate the instrumentation and take care of the data acquisition. The observing rate for stars brighter than ninth magnitude is often around 30 per hour. The telescope is dedicated to Strömgren uvby- β photometry, and the instrumentation consists of one unit, which contains a 4-channel spectrometer and a conventional 2-channel H_{β} photometer. This instrumentation is only taken off the telescope, when the mirror has to be aluminized.

Autocentring is accomplished by scanning two slits, arranged in a wedge shape, across a small area of the sky. This is done by moving the telescope, while sampling the output from the uvby channels every 50 milliseconds. From the double-peaked profile detected, the position of the star is calculated and the star is centred. Of course, this requires positions of highest accuracy. It is recommended to use SAO Star Catalog positions and proper motions or data of similar quality (AGK 3), if possible.

Data acquisition can be done in two ways. An integration can be stopped, either after a specified number of seconds have elapsed, or after a specified number of photo-electrons have been counted in a chosen channel. Before a set of integrations is initiated, either the 4-channel spectrometer or the 2-channel H_{β} photometer must be selected. The data are then recorded simultaneously from four or two channels, respectively.

To operate automatically the system needs at least three files stored on a hard disk:

- (1) A star catalogue containing positions, equinoctium (= epoch), proper motions and identifications. The units of the two components of the proper motion are the SAO units (disregarding the decimal points).

- (2) An output file to store results, error messages, and comments supplied by the observer.

- (3) A so-called command file, containing a set of instructions, which guides the telescope throughout the long, cold and windy night, while the bewildered photometrist sits in the comfortable office (or kitchen), still with too many

layers of warm clothes on and a bit unsure about what to do with all his newfound spare time.

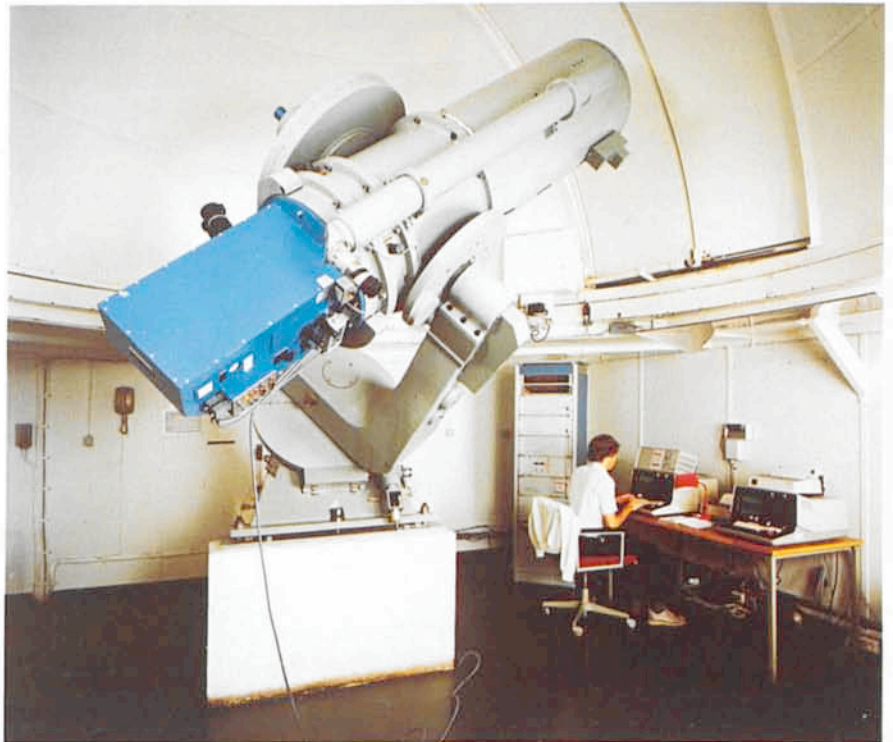
There is a variety of instructions with which to build up the command file. The philosophy is that each instruction should initiate a series of actions, which is a logical operational sequence. Therefore, most instructions are followed (on the same line) by a number of parameters. The most important instruction is OBS, which will slew and/or set the telescope to a selected spot on the sky, initiate an autocentring (if that is wanted), select one of the two instrument sections, select diaphragm size and initiate an integration sequence, the details of which can be specified as mentioned above. In an ordinary observing programme the only difference between successive OBS instructions will be the record number (referring to the star catalogue), which defines the telescope position. This record number may be replaced with N, which selects the next star in the star catalogue. A jump instruction (JMP) makes it possible to define an endless loop, which will observe all stars in the catalogue successively. After the last star has been observed, the next star selected is the first star in the catalogue. Thus, if the catalogue contains only three stars

(e.g., a variable and two comparison stars) many hours of a light curve will be recorded without any intervention from the observer. Of course, there is also an instruction for off-setting to facilitate measurement of the sky background (OFS). The instruction SIT will read the sidereal time and make a jump decision according to the result.

It is obvious that a command file must be prepared with the same care as a computer programme. Further information and details can be found in the manual by P. Nørregaard. It will be sent to you, if you write to E. H. Olsen (Brorfeldevej 23, DK-4340 Tølløse, Denmark).

It is still possible to operate as usual in the human – and, therefore, slow – mode: type in coordinates and equinoctium, set telescope, centre star by eye, select integration stop conditions, type identification, start integrations, etc., all manually. But even for faint stars with less accurate coordinates it is a distinct advantage to use a command file. The instructions can be executed one at a time, and the OBS instruction can be truncated to exclude the integration instructions, so that only a setting and an attempt at autocentring will be made. The observer can then go to the telescope and locate his star.

Finally, a few words about the advan-



The Danish 50-cm telescope on La Silla.

tages of simultaneous multi-channel photometry compared to conventional single-channel photometry. If the seeing is variable on short-time scales, this will affect differently every single filter measurement made with a single-channel photometer, thereby ruining both colour indices and magnitudes. In simultaneous photometry only the magnitudes are

affected, but colour indices are unaffected, i.e., it is still possible to obtain the astrophysical information about temperature, absolute magnitude and metallicity with the highest accuracy. Any variable absorption, *which is grey*, has the same effect on the measurements. This means that field star programmes aiming at, e.g., galactic struc-

ture studies, are unhampered by cirrus clouds. Variable star research with our equipment, however, still requires photometric conditions.

We hope that even more observers will exploit the Danish equipment in the future.

Welcome to the Strömgren Automatic Telescope.

A New CCD Camera for the Echelec Spectrograph

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The Echelec spectrograph, installed at La Silla in 1973, was designed to be used with an electronographic camera. However, by adding a flatfield corrector, it can be operated with other detectors, such as CCD's. As part of the upgrading programme of the 1.52-m telescope, and in order to improve the spectroscopic capabilities of that instrument, the Echelec spectrograph has been modified and is now working with the same CCD detector as used on the Boller and Chivens spectrograph.

The main modifications of the Echelec consist in the installation of a support for the CCD cryostat, a new Echelle grating, a TV slit viewer and a new calibration lamps unit, with flat-field and thorium lamps (and some others possibly available). The motorization of the cross-dispersion device, for automatic selection of the central wavelength, is in progress. An autoguider system should also be installed in the future.

In the present configuration, the Echelec is equipped with a 31.6 gr/mm Echelle grating and a 632 gr/mm Carpenter prism as cross-disperser. The linear dispersion varies from 3.1 Å/mm at 4000 Å to 4.5 Å/mm at 6000 Å. The

cross dispersion amounts to 35 Å/mm. With an RCA chip as the detector, one frame covers approximately 275 Å, in 5 to 10 orders (see Fig. 1). A reasonable order overlap is insured up to 6500 Å, but the presently used flat-field corrector limits the spectral range to wavelengths lower than about 5500 Å. A 15 µm pixel corresponds to 0.65 arcsec on the sky, so that an optimal sampling is obtained with a 1.3 arcsec slit.

A few nights were allocated for the astronomical tests of this new combination in September and October 1987. The use of a 1.4 arcsec slit led to a resolving power of 32,000 (FWHM) as measured on the Th lines. As such, the Echelec resolution falls in between those of the CES with short camera ($R \approx 50,000$) and CASPEC ($R \approx 20,000$). The efficiency of the instrument was estimated by observing the spectrophotometric standard star HR 9087. With the same 1.4 arcsec slit, the measured count rate at 5000 Å corresponds to 0.6 electrons per second per wavelength bin (0.06 Å) for a star of visual magnitude 10. Taking into account the readout noise (57 e⁻ per pixel) and the dark current (60 e⁻ per pixel per hour) of

the CCD chip used (ESO number 13), a S/N of 10 would be reached in 1 hour for a star of $m_V = 10.1$ ($m_V = 7.3$ for S/N = 100) in unbinned mode. A limitation of the present configuration is the rather high readout noise of the CCD chip number 13. Fortunately, the wide separation of the orders allows some binning in the direction perpendicular to the dispersion. This improves the S/N without any loss of resolution. With a binning of 4 pixels, the limiting magnitudes would be $m_V = 10.6$ and 7.7, for a S/N of 10 and 100, respectively, in 1 hour.

To give the potential observer a better feeling of the quality of the Echelec spectra, we reproduce in Figure 2 one order of the spectrum of the solar-type star HR 810, after flat-fielding and calibration in wavelength. The exposure time was 30 minutes, in rather poor meteorological conditions.

In its present state, the Echelec spectrograph is able to produce useful results in the blue-green spectral range (up to 5500 Å). It is expected to help lowering the pressure on the CASPEC and CES spectrographs. Further improvements should allow to extend the

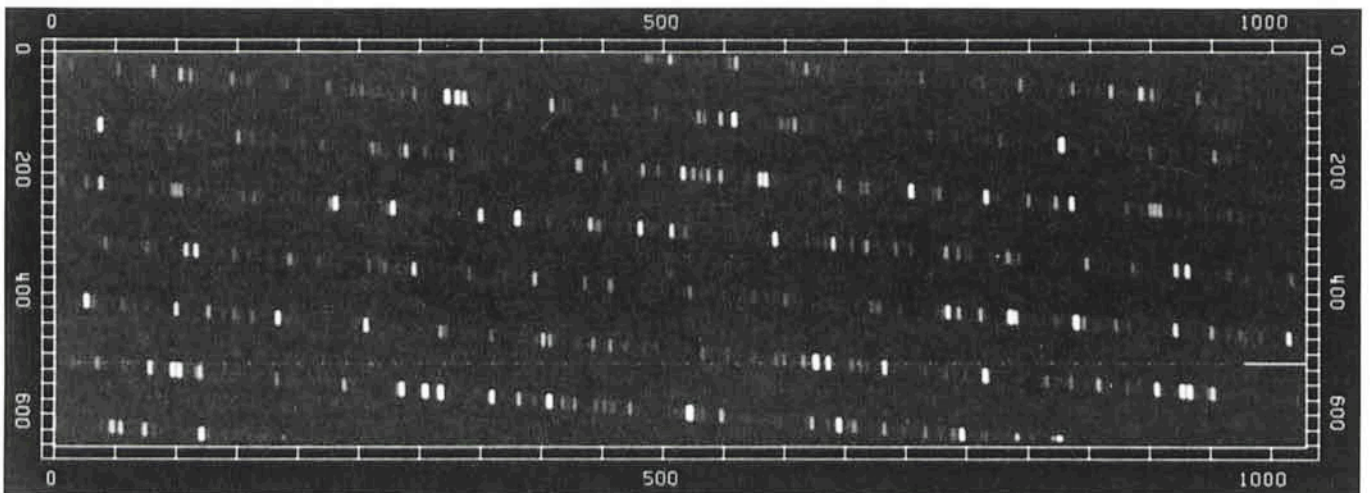


Figure 1: CCD frame of the Thorium hollow cathode lamp in the region 5300–5600 Å.