are associated with columns. The methods currently available are:

– Principal Components Analysis, to produce the projection of the data matrix onto the principal axes.

– Cluster Analysis, using hierarchical clustering with several agglomerative criteria (single link, complete link, minimum variance, etc.).

– Fast iterative non-hierarchical clustering methods.

In this context, the tables in MIDAS provide a bridge between the raw data and the algorithms for analysis. Data originally in the form of images or catalogs can be put into the analysis program by structuring the extracted information as tables, a natural way of representing the objects in the parameter space.

These commands are in an experimental state. Work is ongoing in making more statistical methods available within the interactive framework of MIDAS. Special attention will be given to the friendliness of usage by means of display facilities and easy interaction. Unlike many statistical packages commercially available, MIDAS offers the advantage of integrating image processing algorithms with extensive graphics capabilities and, of course, the statistical methods.

The linking-up of data collection and of statistical data analysis – of database creation and of an important use to which a database is put – is also of singular importance. The future existence of an ESO and of a Space Telescope archive creates exciting possibilities for the possible use of multivariate statistical procedures on a large scale. A step of far-reaching implications was taken a few years ago when the large-scale archiving of data was linked to the down-stream analyzing (by multivariate statistical methods) of such data: this was when Malinvaud, head of the French statistical service (INSEE), strongly linked the two together (Malinvaud and Deville, 1983). Multivariate statistical analysis of data requires that the data collection be competently carried out; and, in return, it offers the only feasible possibility for condensing data for interpretation if the data is present in very large quantities.

A Collaborative Future

Current trends in astronomical research not only create prospects for statistical methods to be used, but for reasons mentioned in this article they require them. The flow will not be just one-way however: statisticians will also learn from the problems of astronomy. Computational problems related to the large amounts of data which must be handled, the best ways to treat missing values and mixed qualitative-quantitative data, and even the most appropriate statistical methods to apply – all these and many more currently unforeseen issues will lead to a very fruitful and productive interaction between methodologist and astronomer over the coming years.

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NEWS ON ESO INSTRUMENTATION

The following information on instrumentation has been provided by the Optical Instrumentation Group.

The ESO Multiple Object Spectroscopic Facility "OPTOPUS"

OPTOPUS is a fiber-optics instrument intended for multiple-object spectroscopy with the Boller & Chivens spectrograph and a CCD detector at the 3.6 m telescope. Using the Optopus system, the spectra from up to 47 independent objects located within a 33 arcmin field can be simultaneously recorded.

Overall View of the System

For multi-object observations, the B & C spectrograph is mounted on a separate frame within the Cassegrain cage of the 3.6 m telescope and a special fiber optics adaptor is fixed to the Cassegrain flange. The adaptor serves as a support for metal templates (starplates) containing precisely drilled holes (corresponding to the objects of interest for a given observed field) into which the individual fibers are connected. The fibers, serving the purpose of a flexible light transport from focal plane to spectrograph, are terminated together at their output ends in a closely packed row which replaces the conventional B & C entrance slit.

For guiding and alignment purposes, each starplate must also contain bundle connector holes for two guidestars, which are then observed from the control room by means of coherent fiber bundles and a TV camera mounted on the Optopus adaptor.

The usual B & C off-axis F/8 collimating mirror is replaced by an F/3 dioptric collimator to improve the efficiency of the system. On the RCA CCD detector, a single fiber is matched to 2.1 pixels and the individual spectra are separated by 4 pixel-high unexposed bands. The choice of grating determines the spectral coverage and resolution, exactly as in conventional use of the B & C spectrograph. One must consider that the resolution limit (determined by the fiber core diameter instead of a chosen slit width) is between 2 and 3 pixels, and that the length of the CCD in the direction of dispersion is 15 mm (~500 pixels).

The efficiency of Optopus should be comparable to that of the spectrograph used in normal mode, with some losses introduced by fiber/object misalignments and by material absorption in the fibers. For an object with m_v = 18 it is expected that a S/N ≥ 10 can be achieved at 170 Å/mm after a one-hour exposure, using the present CCD. The efficiency of the system begins to drop sharply below 3900 Å due to a combination of poor UV transmission in the fibers and reduced blue quantum efficiency of the CCD.

Preparation of the Starplates

Starplates for Optopus observations are prepared in the ESO workshop in Garching, using computer generated drilling machine instructions recorded on cassette. This is achieved, starting with a suitable (α, δ) coordinate file which is processed by a dedicated interactive computer program (OCTOP). For this purpose, astronomers to whom Optopus observing time has been granted will be required to travel to Garching at least two months in advance of their observing run at La Silla. ESO will support this trip as an integral part of the observing program. If the astronomer does not have accurate coordinates for the objects he wishes to observe, he can use a measuring machine and the astrometric program at ESO on his own photographic plates (or on sky survey plates) to obtain the source file for OCTOP. An auxiliary plotting program supplies the astronomer with a correctly scaled and numbered map of each processed starplate field.

Summary of Physical Constants and Constraints for OPTOPUS Starplates

Field scale:	7.140 arcsec/mm
Maximum field:	274 mm (33 arcmin) diameter circular field
Fiber size on sky:	2.6 arcsec
Maximum number of objects:	47
Optimal coordinate precision:	0.2 arcsec (transmission losses are of the order of 5 % per 0.1 arcsec coordinate imprecision, for a seeing of 2 arcsec)
Number of guidestars:	2
Faintest guidestar magnitude:	16
Maximum magnitude difference for guidestars:	2.5
Minimum object-object separation:	3.4 mm (25 arcsec)
Minimum guidestar-object separation:	9 mm (64 arcsec)

The Limiting Capability of EFOSC

EFOSC, the ESO Faint Object Spectrograph and Camera has been described in the ESO Messenger No. 38, page 9. The operating manual will be available at the end of August. The first run of the instrument for visiting astronomers will take place in September.

In three test nights in March 1985, observations were performed to establish the limiting capability of the instrument. While the detailed results will be published elsewhere, we report here the values which can be helpful in planning the observing program.

In *direct imaging,* we analyzed a series of exposures in the V an B band of a selected area in the cluster W Cen.

With the present setup (CCD # 3) and a seeing giving stellar images of FWHM = 1.3 arcsec, we detected stars of m_v = 25 at S/N ≃ 3 in a 15-minute V exposure, the main source of noise being the statistical noise of the sky background. In this exposure, stars of m_v ≃ 17.5 saturate the CCD. A well-defined HR diagram has been obtained down to V magnitude ≃ 23.

In *slit spectroscopy,* several spectra of objects in the 20–22 V magnitude range were recorded at a dispersion of 230 Å/mm. With a slit of 1.5 arcsec, the resolution is ~15 Å. The S/N of the final spectra are between 5 and 10.

The *grism mode,* in which the dispersing element and possibly a filter are inserted in the optical beam of the spectrograph but no slit is used, should be a powerful tool to survey selected regions of the sky for different types of objects. We have used it only to search for QSO candidates in an area which had been looked at on a CFHT grens plate. At 900 Å/mm, the continuum of objects of m_v = 22 is well recorded in a 5-minute exposure. The best results were obtained when a B or a G Gunn filter were used to reduce the length of the spectra and the sky background. A cursory inspection of three EFOSC fields has led to the discovery of a new QSO with m_v ≃ 21 and z = 3.27.

The Multiple Object Spectroscopy (MOS) Mode of EFOSC

In MOS, the EFOSC standard slit is replaced by a number of holes or rectangular slitlets, each exactly positioned on an object. The apertures are punched in a starplate, each one producing a spectrum. Theoretically, as many as 30 objects can be recorded if they fall within the MOS field of view, which is 3.6′ × 4.5′. Figure 1 shows an image of a starfield (made with EFOSC in direct imaging), Figure 2 the multiple spectra that were obtained.

In order to prepare a starplate, one needs to know the positions of the objects to sub-arcsecond accuracy. The procedure that was developed at ESO totally relies on the imaging capabilities of EFOSC. First, a direct image is obtained where positions are measured using the on-line data reduction system (IHAP). A drill coordinate list is then produced and it is sent to a dedicated machine which punches the starplate. The whole procedure will be the astronomer's responsibility.

The finished starplates are mounted in the EFOSC aperture wheel by an ESO operator during the following day and, on the second night, aligned on the sky again using EFOSC in direct imaging. Two images of the starplate and the starfield are compared, using IHAP, and the telescope offset and field rotation necessary to minimize position errors are computed. About 15 minutes are necessary for the alignment.

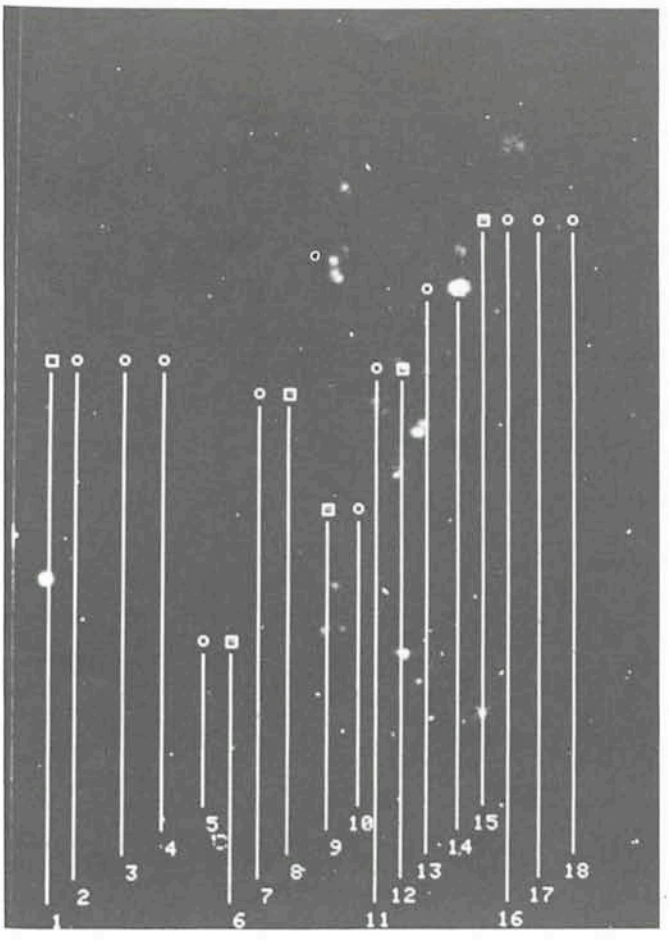


Figure 1: *This image shows HII regions in the spiral arms of M 83 with strong [OIII] emission. The overlayed, numbered boxes represent aperture requests for the punching machine: square boxes represent object holes, the round ones are sky holes. The image was obtained by subtracting an exposure taken through a narrow filter on the continuum from one centered on the emission line.*

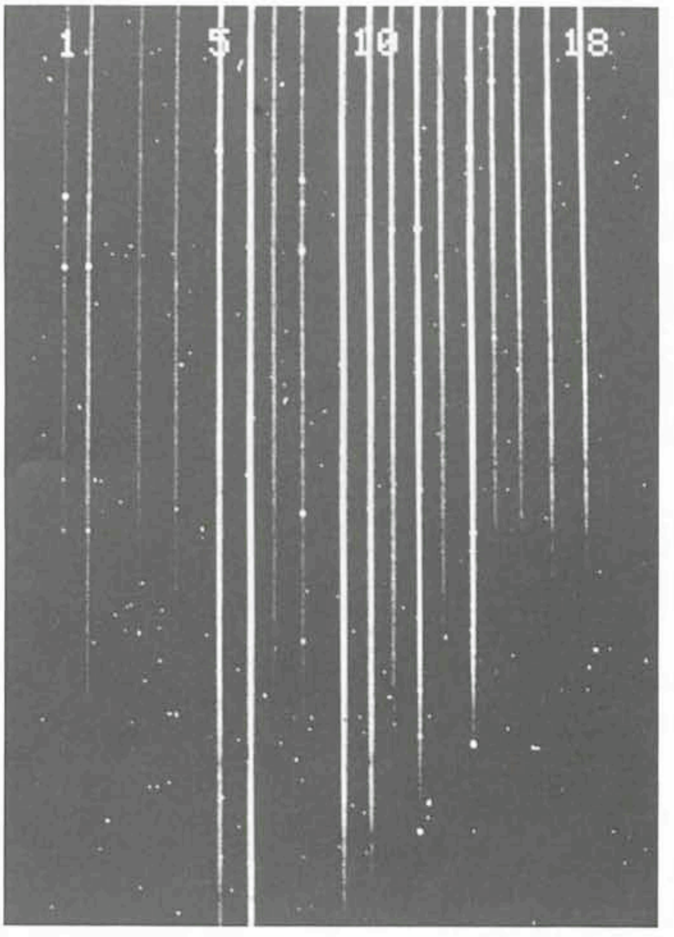


Figure 2: *The multiple spectra that were obtained from the aperture plate prepared from the image shown in Figure 1. The dispersion is 130 Å/mm and the wavelength coverage λλ 3700–5400 Å. The exposure time was 30 minutes. Point-like spots are radiation events on the CCD. The spectra are numbered as the apertures in Figure 1.*

The punching machine is being built in the framework of a collaboration between ESO and the Observatoire du Pic du Midi et de Toulouse; it will be tested at the telescope next February. MOS as described here will be offered for general use as of April 1986.

A New Short Camera at the CES

This new, faster camera is a dioptric system with aperture 2.5.

It is foreseen to use it with an RCA SID 503 CCD, with 640 × 1024 pixels, 15 μm square in size. Typical features of this new camera-detector combination are:

- linear dispersion 2.7 Å/mm at 5000 Å,
- resolution with 1.2 arcsec slit about 60,000,
- spectral coverage in one CCD exposure 42 Å.

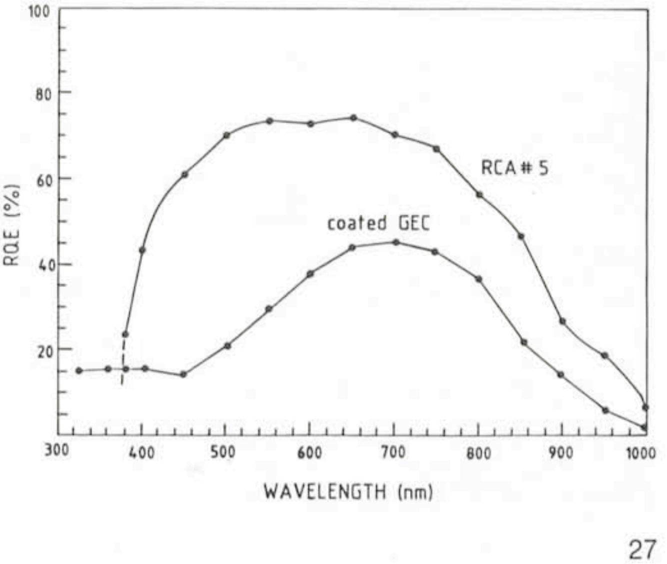
The gain with respect to the present MAKSUTOV Camera (Long Camera) + Reticon combination should be of 1.5–2 magnitudes at comparable resolution in the blue-visual region. The actual value will depend on the quantum efficiency and read-out-noise of the CCD, which are now being measured.

The first tests at the telescope are foreseen in December 1985.

CCDs in Use at La Silla

There are at present four CCDs in operation at different telescopes and instruments at La Silla. Three are from RCA and one is a GEC coated in the ESO detector laboratory with a fluorescent plastic film to enhance the UV quantum efficiency. The table summarizes their basic parameters and performance. Some of these values could be slightly different during your actual observing run.

The format of the RCA CCD is 320 × 512 pixels, 30 μm square in size. The GEC is 385 × 576 pixels, 22 μm square in size. The responsive quantum efficiencies of the RCA # 5 and of the coated GEC CCD are shown in the figure. The RCA # 3



Dewar #	1	3	6	5
Telescope	Danish 1.54 m	3.6 m	3.6 m / 2.2 m	2.2 m
Chip type	RCA SID 53612	RCA SID 501 EX	GEC P8603/A Fluor. coated	RCA SID 501 EX
e^-/ADU and gain*	18 at G50	11 at G50	8.5 at G100	11 at G30
Read out noise (e^-)	85	45	28	45
Charge transfer efficiency	150 ADU of background needed	Generally no charge smearing	~100 ADU of background needed	Generally no charge smearing
Blemishes	Some hot spots and 1 poor column	one hot column	A few partly dead columns	1 hot column, a hot spot at the on chip amplifier

has a behaviour similar to #5. The curve of RCA #1 has not been measured in detail. With respect to the other two it has a somewhat lower peak efficiency in the visual-red region but a better sensitivity in the UV region.

The saturation level of all of the CCDs is at present determined by the digital-analog-converter. This being limited to 16,000 ADU, saturation occurs for a number of electrons which depends on the operating gain.

In period 37, two new CCDs should be in operation. One is a RCA type SID 503 with 640 × 1024 pixels, 15 μm in size. It is going to be dedicated to the short camera of the CES and it is currently being tested. An additional coated GEC should also be available with the 2.2 and 3.6 m instruments.

Note, finally, that the present distribution of CCDs might be subject to changes if this is judged necessary by the ESO Directorate.

El Cometa Halley observado desde La Silla

Mientras el periódico cometa Halley se acerca rápidamente al sol, se están haciendo preparativos en muchos lugares para observar este distinguido objeto celeste. Durante la mayor parte de los meses junio y julio de 1985 Halley se encontraba "detrás" del sol y no podía ser observado. Desde aproximadamente el 18 de julio se intentó tomar imágenes de Halley en varios lugares y quedó verificado ahora que las primeras visiones confirmadas fueron hechas desde el Observatorio Europeo Austral el día 19 de julio.

En esa fecha Halley se encontraba en la declinación +18 grados y sólo a 30 grados al oeste del sol. El único telescopio en La Silla capaz de apuntar en esa dirección es el astrógrafo doble de 40 cm (GPO), el telescopio más pequeño en La Silla; y se dudaba del resultado obtenido del intento de observar Halley, durante el cual habíamos logrado obtener tan solo una placa en esa mañana. Una vez procesada, la placa fue inspeccionada muy cuidadosamente – mostraba estrellas de magnitud 16 y aun mas débiles, pero no se registraba una clara imágen del cometa.

Después de mi regreso a ESO Garching hacia fines de julio, el fotógrafo de ESO K. Madsen, y yo decidimos estudiar las placas más detalladamente. Se confeccionó una copia de la placa ampliada fotográficamente (este método permite ver mejor los objetos muy débiles y lejanos) y la placa fue medida en el instrumento de medición S-3000. Y verdaderamente se podía divisar un objeto muy débil y difuso cerca de la posición esperada. No correspondía a ninguna imágen del Atlas de Palomar. Aunque difícil de medir, se pudo transmitir una posición al Dr. Marsden de la Oficina de Telegramas Central de la Unión Astronómica Internacional.

Aunque este hecho no tiene un gran valor científico, encierra buenas perspectivas para las observaciones de ESO del cometa Halley a mediados de febrero de 1986, cuando éste reaparezca detrás del sol. Entonces nuestras observaciones serán bastante más importantes porque contribuirán esencialmente a la navegación de las aeronaves espaciales que están ya en camino hacia Halley para encuentros cercanos. Y naturalmente, siempre es agradable ser el primero, al menos de vez en cuando . . .! R. WEST

Contents

ESO, the European Southern Observatory, was created in 1962 to . . . establish and operate an astronomical observatory in the southern hemisphere, equipped with powerful instruments, with the aim of furthering and organizing collaboration in astronomy . . . It is supported by eight countries: Belgium, Denmark, France, the Federal Republic of Germany, Italy, the Netherlands, Sweden and Switzerland. It operates the La Silla observatory in the Atacama desert, 600 km north of Santiago de Chile, at 2,400 m altitude, where thirteen telescopes with apertures up to 3.6 m are presently in operation. The astronomical observations on La Silla are carried out by visiting astronomers – mainly from the member countries – and, to some extent, by ESO staff astronomers, often in collaboration with the former. The ESO Headquarters in Europe are located in Garching, near Munich.

ESO has about 135 international staff members in Europe and Chile and about 120 local staff members in Santiago and on La Silla. In addition, there are a number of fellows and scientific associates.

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