The Coudé Echelle Spectrometer

One of the most important auxiliary instruments for the 3.6 m telescope is a high-resolution spectrograph. This instrument, the coudé échelle spectrometer, will work on the floor below the telescope, in the air-conditioned coudé room. It is here described by Daniel Enard of the Optics Section in Geneva who is working full time on this project:

The coudé échelle spectrometer of the ESO 3.6 m telescope is designed to reach a very high resolution (typically higher than 100,000) with a good photometric accuracy. The spectrometer will work in two possible modes. The first is a scanning mode where an alternatively rotatable échelle 200 x 400 mm moves the spectrum with regard to a fixed slit, the photon flux being detected by a high quantum efficiency cooled photomultiplier. In order to get a higher accuracy, the beam passes, in fact, twice on the grating. The dispersion is doubled and the beam focused on an intermediate slit, the instrumental profile, i. e. the system response to a perfect spectral line being made as pure as possible. Any wings and ghosts given by the grating or the optics are removed.

The second mode uses a multi-channel electronic detector. The échelle grating is set in such a way that the interesting spectral region is centred on the detector. From then the photons are simultaneously detected in each channel and added in a computer memory.

To reach the very high accuracy expected, particularly with the scanning mode, one has to rely very much on the accuracy of the turn-table upon which the grating is set.

Recent developments in ultra-precision angular measurements and servo control systems allow angular accuracy expectation of 0.1 arcsec, with scanning frequencies up to 5 hertz. These high frequencies (if one takes into account the mass of a 400 mm grating) allow the system to be freer than in the past from the atmospheric noise, an important limiting factor.

The instrument is composed of four parts:

1. Slit Environment

Auxiliary but essential functions like TV acquisition, guiding, spectral and photometric calibration are performed here, before the entrance slit.

2. Pre-disperser

Ensures the order separation, necessary with an échelle grating. This is a medium-dispersion prism monochromator.

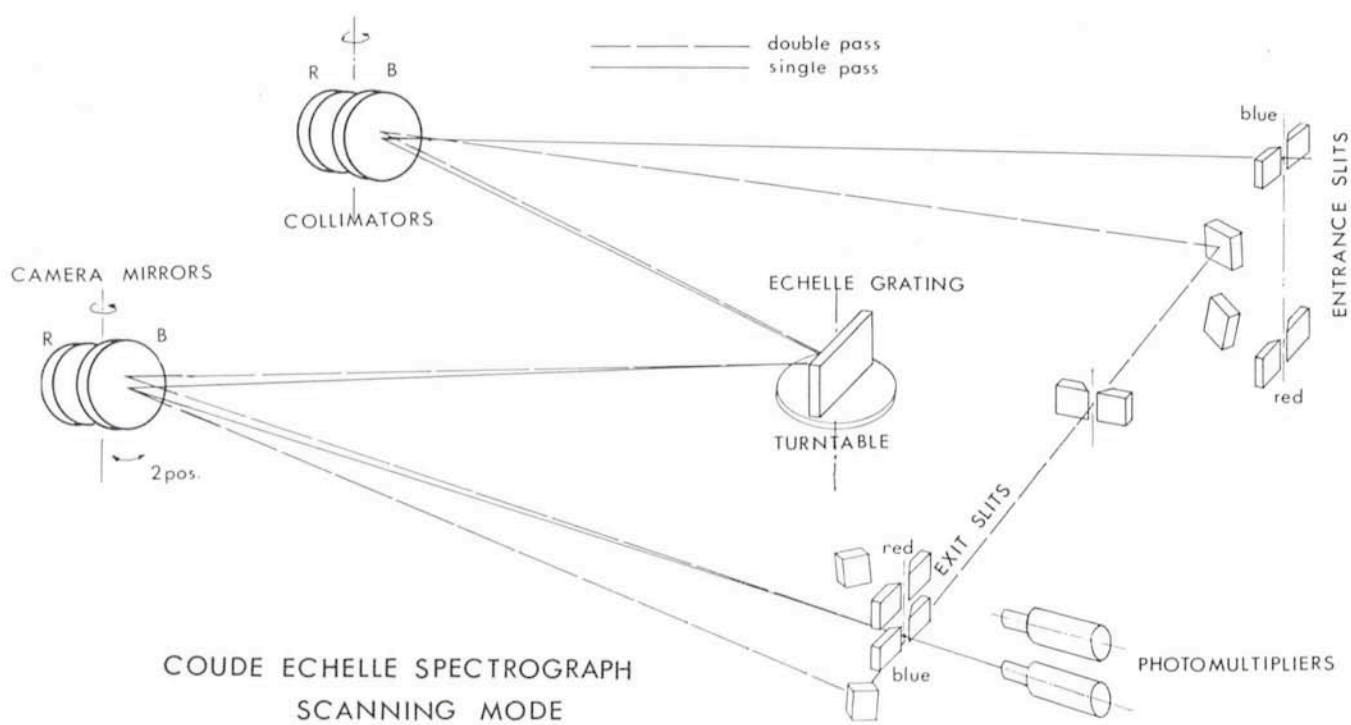
3. Scanner

This is a classical CZERNY TURNER arrangement. The angle between the beams has been exaggerated on the figure but is in fact kept very small (about 5°) to get maximum grating efficiency. For the spectrometer as well as the pre-disperser, two opticals paths can possibly be pursued—one is optimized for a maximum transparency in the blue, the other in the red. Shifting from red to blue path is achieved by tilting pre-positioned mirrors.

4. Multi-channel Camera

This is a unit which is set up on the diffracted beam between the grating and the camera mirrors. The camera itself is a Schmidt system with a relative aperture of f/5.

It is foreseen at present to use two types of detector—a reticon for work in infrared or for bright objects and a digicon for visible, low light level observations. The digicon is an intensified reticon where the diode array is put into the intensifier and directly bombarded by accelerated electrons. The device takes advantage of the extreme simplicity



COUDE ECHELLE SPECTROGRAPH
SCANNING MODE

and reliability of the reticon array, of the very good spatial resolution given by an electron beam and of the very high gain obtained with a high accelerating potential. The digicon can be compared to other detectors as being an analogue detector but with nearly photon shot noise limited performance. Both reticon and digicon will have one row of 1872 diodes, 15 x 750 microns.

The instrument relies heavily on remote control and, except for the change of optical path, the instrument will be fully operated from the control room. The observer will type in the central wavelength and the resolution, and the computer will set the slit widths, the pre-disperser prism and the grating correctly. Even the manual settings will be indicated by the computer, so the observer can be warned of any mistake before the observation starts. For both modes (except with the reticon) the signal will be available in real time, the observer will have a direct view on a graphic display of how the spectrum looks and he will end the integration when the signal-to-noise ratio seems sufficiently high for his purpose (this is, of course, a tremendous advantage over photographic plates). A possible improvement of the instrument would be to move towards larger mosaic gratings but this leads to huge and very expensive cameras. An interesting possibility is to use two contiguous échelle gratings blazed at 75°. Then either dispersion of efficiency could be doubled without modifying anything else in the instrument.

The actual schedule is to have the instrument working in the laboratory by the end of 1978, the shipping to Chile being foreseen in April 1979.

PERSONNEL MOVEMENTS

(A) Staff

ARRIVALS

Geneva

Scientific Group: Klaus Banse (German) systems analyst/programmer, 12.12.77.

TRANSFERS

Marianne Fischer (German), secretary; from Garching to Geneva, 1.1.78.

DEPARTURES

Geneva

Instrument Development Group: Johannes van der Lans (Dutch), senior project engineer (electronics), 31.12.77.

(B) Paid Associates – Fellows – Coopérants

ARRIVALS

Geneva

Scientific Group: Manfred Pakull (German), fellow, 1.12.77.

DEPARTURES

Geneva

Scientific Group: Dan H. Constantinescu, fellow, 31.12.77.

LATEST NEWS

Further Observations of ESO 113-IG45

By monitoring the nucleus of 113-IG45 with the ESO 50 cm telescope, Drs. N. Vogt (ESO) and H. Duerbeck (Tübingen) find a 2 per cent variation in the B magnitude over a period of ten days (November 8–18)

Drs. W. Wamsteker, P. Salinari and M. Tarenghi have detected 113-IG45 with the infrared photometer at the 1 m telescope on La Silla.

ALGUNOS RESUMENES

Extinción en La Silla

Hay dos factores de vital importancia que determinan la calidad del lugar de un observatorio. Son el *"seeing"* (en qué grado es esparcido la luz de un objeto celestial durante su paso por la atmósfera terrestre) y la *extinción* (cuánto se debilita la luz durante su paso). Desde hace tiempo se sabe que el "seeing" en La Silla es excelente, pero sólo recientemente un detallado estudio ha revelado que la extinción de La Silla es muy baja en una "buena noche".

El estudio fue hecho por el Dr. H. Tüg del Instituto Astronómico de la Universidad del Ruhr en Bochum, República Federal de Alemania, quien permaneció varios meses en La Silla desde 1974 hasta 1976. Las mediciones, llevadas a cabo en el telescopio Bochum de 61 cm, comprobaron que la extinción en La Silla es más baja que en cualquier observatorio del hemisferio norte. Durante buenas noches es aproximadamente cinco veces menor que en los mejores lugares de observación en California y Arizona. Esto confirma que La Silla es uno de los mejores lugares de observación del mundo, no sólo a causa de su gran número de noches claras, sino también por la transparencia del cielo.

Estrellas variables en IC 5152

Uno de los mejores métodos para determinar la distancia a una galaxia cercana es medir los períodos y magnitudes de las llamadas cefeidas en la galaxia. Las cefeidas son estrellas variables que se encuentran comparando las placas fotográficas de la galaxia tomadas en distintas noches. Los Drs. Svend Laustsen y Gustav Tammann del Grupo Científico de ESO en Ginebra han analizado recientemente placas de la galaxia IC 5152.

De una fotografía tomada por D. S. Evans («Fotographic Atlas of Southern Galaxies», 1957) se puede llegar a la conclusión que la galaxia enana irregular IC 5152 se encuentra relativamente cercana, y por esta razón debe ser miembro del Grupo Local de galaxias.

Las primeras placas de IC 5152 tomadas en diferentes colores con el telescopio de 3,6 m en La Silla no sólo muestran muchas estrellas supergigantes azules y muy rojas y algunas regiones H II extendidas — que ya habían sido observadas por J. L. Sérsic (Atlas de Galaxias Australes, 1968) — sino también han llevado al descubrimiento de las primeras tres estrellas variables en este sistema. Aun no se conoce ningún período para estas variables, pero su color, amplitud y la escala de tiempo de su variabilidad las hacen aparecer buenos candidatos para ser cefeidas.

Un cálculo muy aproximativo de la distancia de IC 5152 indica 1,5 Megaparsec. Esta distancia sugiere que el Grupo Local de galaxias es algo más grande que el radio de 1 Mpc que se había adoptado convencionalmente. Se proyectan más trabajos en IC 5152 y se espera que éstos lleven a una determinación más segura de la distancia, la que no sólo ayudará para definir el porte del Grupo Local, sino que también proporcionará un importante calibrador adicional de la escala de distancias extragalácticas.