the eclipse has not yet begun; at 1 : 24 the bright star in the system has dimmed notably; at 1 : 28 it is completely eclipsed; it weakly reappears at 1 : 31 and reaches its normal brightness at 1 : 35. The exposure time was three minutes for all frames. The main spectral response is in the red region since no filter was used.

Folding the data with the (orbital) period of 187 minutes yielded a smooth, sine-shaped (full amplitude ~0.6 mag) light curve outside eclipse which occurs half a period after maximum light. Its depth is at least 4.8 mag and the time between first and last contact amounts to about 12 minutes. In fact it must be deeper and narrower since due to the relatively long integration time its true shape is not resolved. Thus PG 1550+131 exhibits eclipses which are among the deepest if not actually the deepest ever recorded for a binary. Two EFOSC spectra obtained near maximum respectively minimum light demonstrate that the Balmer emissions (indicatively superimposed on absorptions) disappear near minimum light, leaving the Balmer series in absorption.

These results show that PG 1550+131 is a precataclysmic rather than a cataclysmic binary. It consists of a small hot degenerate object (very probably a white dwarf with T ≈ 18,000 K) and a late main-sequence star (T ≈ 3,000 K) which does not yet completely fill its roche lobe to enable mass transfer to the compact object typical for cataclysmic binaries. The compact object is heating up the facing side of the companion to about 6,000 K, thus producing the sinusoidal shape of the light curve during orbital revolution. The heated hemisphere is also responsible for the emission lines which cannot be seen near the eclipse of the compact object.

Only very few eclipsing systems in this transitory phase are known so far which allow an accurate determination of the basic parameters that in turn place constraints on those for cataclysmic variables. A detailed study of PG 1550+131 may therefore contribute to our knowledge of both the precataclysmic as well as the cataclysmic states of binary evolution.

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Report on the Last Observing Run of Multiobject Spectroscopy: OPTOPUS is Alive and Kicking

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1. Fibre Multiobject Spectroscopy at ESO

The ESO fibre facility for multiobject spectroscopy at the Cassegrain focus of the 3.6-m telescope, OPTOPUS, has been operating since March 1985. A complete description of the system is given in the ESO Operating Manual No. 6. It is possible to observe with OPTOPUS a maximum of 52 objects distributed over a field of 33′. Special aperture plates are prepared in advance of the observations in the ESO workshop from accurate α and δ coordinates of the selected objects. These plates are eventually mounted at the telescope and the fibres are manually inserted in the apertures; at the other end they form the entrance slit of a CCD spectrograph. In the last four years OPTOPUS has been used in 33 nights for 14 different programmes. It has always operated with high reliability, collecting some 6,000 spectra. The limiting magnitudes at a resolving power of about 500 in the visual are about 18.5 for galaxies and 20 for quasars in a two-hour exposure. While these limits allow useful work for a large number of programmes, there are two aspects of the present system which must be considered as unsatisfactory: the poor blue-UV transmission of the fibres and the reduced efficiency of a number of them, mainly due to imperfect centring of the microlenses at their input ends. As the interest in using

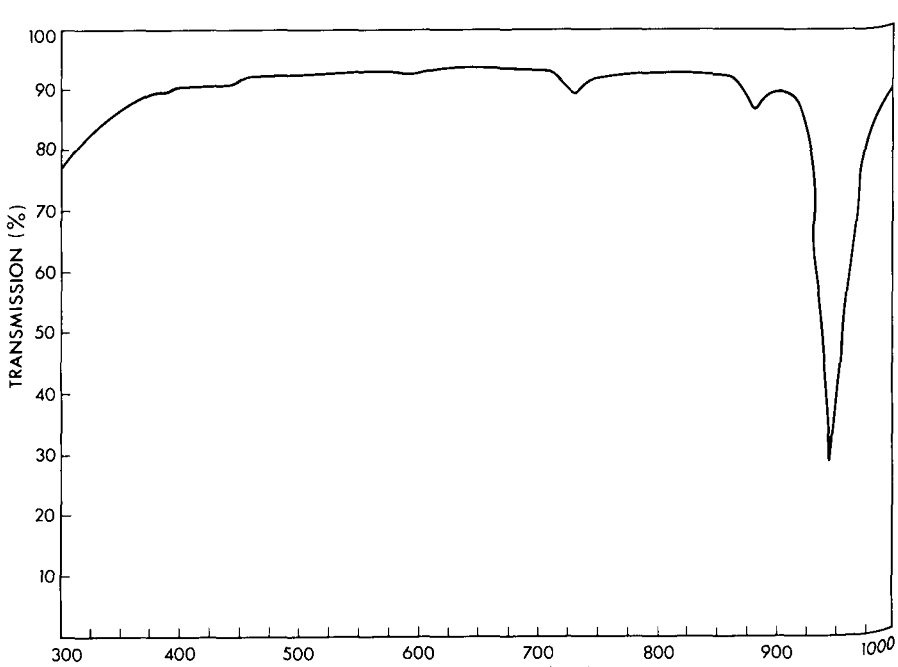

Figure 1: *Total transmission (including reflection losses) of a 3-m polymicro fibre used in the new OPTOPUS head.*

the facility is actually increasing (see e.g., DAEC Workshop, 1988), ESO started a programme to improve the weak points while keeping the basic concept unchanged.

2. The New Configuration of the OPTOPUS Head and the Future Steps to Improve of the Facility

Extensive tests on the efficiency and focal ratio degradation of different commercial fibres were carried out in the ESO laboratory (Avila and D'Odorico 1988, Avila 1988). The fibre selected for the new OPTOPUS head was an all silica, wet (high contamination by the OH radical to enhance the UV transmission) fibre from Polymicro. The transmission of 3 metre of this fibre is shown in Figure 1. A prototype head based on 31 fibres was prepared in the ESO fibre laboratory and in the workshop in the first half of 1988. At their input ends, the fibres were polished and mounted in connectors which fit in the standard aperture on the OPTOPUS plates. In this way the fibres are placed "naked", that is without microlenses, in the focal plane of the telescope. With a core of 320 μm, they subtend 2.3 arc sec on the sky and since they preserve well the beam focal ratio, they can still be used with the F/8 collimator of the ESO B & C spectrograph. From laboratory measurements of the average efficiency of the fibres in the old head and in the new prototype, we could predict an improvement in the efficiency by a factor of two. This was essentially confirmed by the observations (see below) which indicate a gain of about one magnitude with respect to previous results.

By the end of 1989, ESO plans to implement a new head with 50 fibres to be coupled with a new F/6 dioptric collimator now on order. In the final configuration, the upgraded OPTOPUS will be a highly efficient instrument. Further improvements can be expected when CCDs with high efficiency and lower read-out-noise become available.

The weak point or if you want the bottleneck of the facility will then rest in the preparation of the aperture plates in the ESO workshop. It is a demanding operation in terms of manpower and ESO is forced to set an upper limit to the number of plates which can be prepared for a given observing run. The way to solve this problem is by building a system in which the fibres are positioned at the location of the targets in the focal plane of the telescope by a mechanical device under computer control. Two systems of this type have recently been put in operation: one at the Steward Observatory (Hill and Lesser, 1988) and the other at the AAT (Parry and Gray, 1986). ESO is currently discussing the procurement of an analogous facility through a joint project with the Observatory of Meudon. This will take time, however, and ESO will continue to offer the aperture plate version for the next three years.

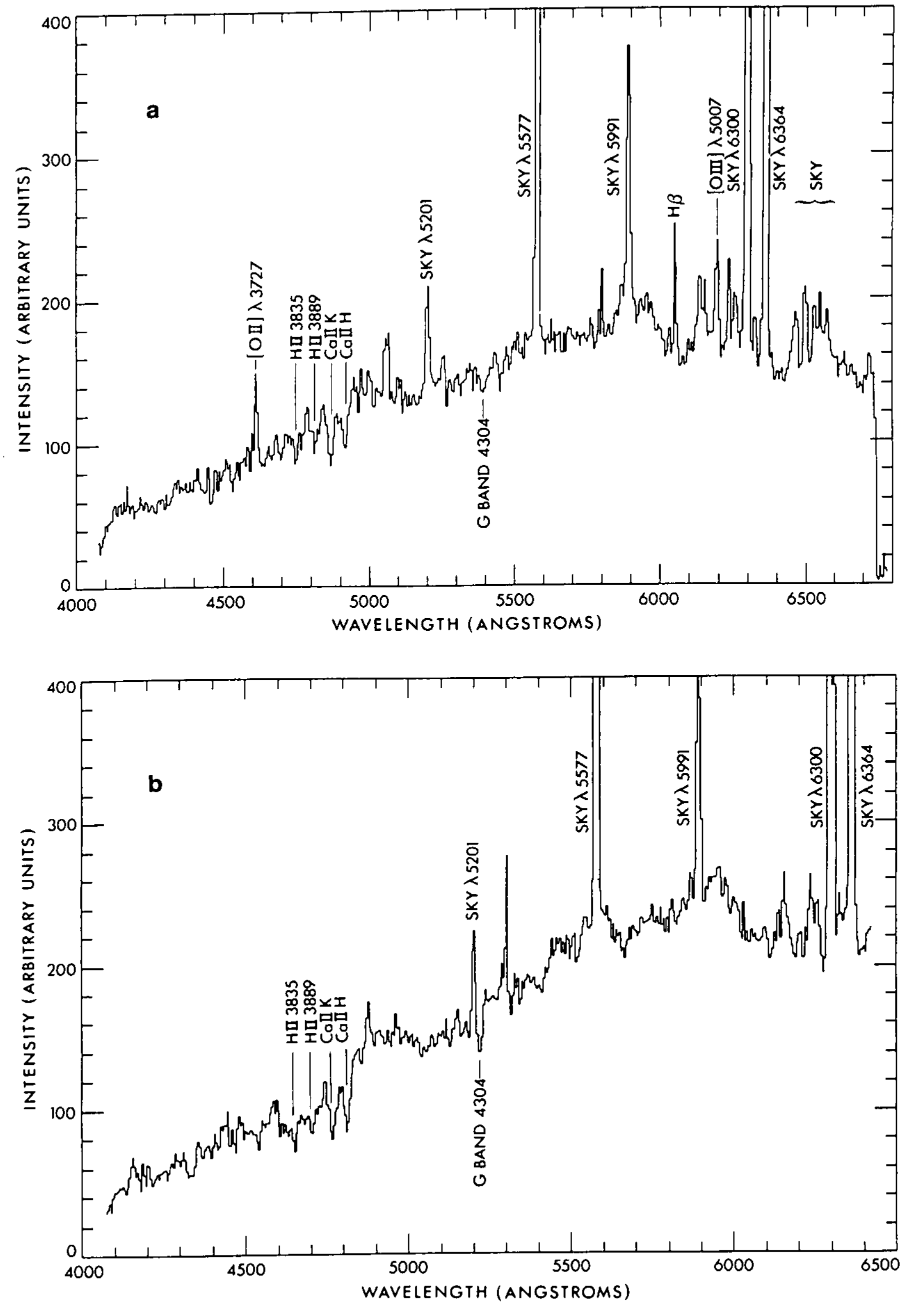

Figure 2: *Spectra of two galaxies from the average of two 30-minute OPTOPUS exposures (a: bj = 19.5, z = 0.24; b: bj = 18.4, z = 0.12). The magnitudes are COSMOS derived values for the entire galaxy from ESO-SRC J. survey plate. The sky has not been subtracted. The redshift is estimated from the H and K lines.*

3. The Observations in September 1988: Probing the Feasibility of a Faint Galaxy Redshift Survey

Two of us had obtained 4 nights of observing time with OPTOPUS to investigate the possibility to use the system for extensive surveys of galaxy redshifts at faint magnitudes (see Guzzo and Tarenghi, ESO Internal Report, October 1987). The use of an efficient fibre spectrograph would reduce by a factor of 20–30 the telescope time normally necessary for such a kind of work, while allowing on the other hand to study the galaxy distribution to much fainter limiting magnitudes than those of the deepest existing wide-angle surveys (which are presently limited to m < 15.5, see e.g. Geller et al., 1988 and Giovanelli et al., 1988). Indeed, to have 30–50 galaxies in the OPTOPUS field, one has to select a sample limited to magnitudes as faint as bj < 18.5–19 (where the magnitudes are measured from plates of the ESO-SRC sky survey, J colour): at these magnitudes the mean density of objects over the field matches the total number of fibres and the instrument can then be used at its maximum efficiency. It was a clear conclusion of the feasibility study that it would be possible to carry out the survey to such a depth at a rate of about 1.5 square degrees per night. This means that, for example, to survey a strip of 100 x 1 square degrees would take about 70 nights of 3.6-m telescope time. Here we are not going to enter into details neither on the best way to conceive such a survey, nor about the fundamental importance that its results would have for the study of the topology of the Universe and consequently for the theory of galaxy and large-scale structure formation. For an excellent discussion of these points see the review article by Rood (1989).

Before starting the run, it was planned to use the new prototype head just for a couple of nights for testing, and then shift back to the old version for the rest of the programme. After the first spectra were obtained, the improvement in efficiency was so evident that it was decided to go on with it for the whole run.

The ESO grating no. 15 was used together with the f/8 collimator and f/1.9 blue camera of the B & C spectrograph. This combination gives a dispersion of 170 Å/mm and a resolution (FWHM) around 10 Å. This dispersion is quite appropriate to study the distribution and rms velocities of galaxies, for which it is necessary to keep rms errors on cz to less than 50 km/sec. We plan to measure eventually the redshifts using cross-correlation with template spectra (generally of a bright galaxy or a K-type star): this technique permits to reach rms errors on z between 1/25 and 1/10 of the nominal resolution, depending on the S/N ratio of the spectrum. This corresponds in our case to errors in cz between 25 and 60 km/sec.

The OPTOPUS starplates were prepared in Garching in June 1988. The galaxy magnitude limited samples were extracted from a subset of the Edinburgh-Durham Southern Galaxy Catalogue (EDSGC) under completion in Edinburgh (Heydon-Dumbleton et al., 1989), kindly provided by the authors. We observed three areas of 1, 3 and 0.2 square degrees around the South Galactic Pole, all at the same declination and with right ascensions around 22 h, 00 h and 03 h, respectively. The largest region is centred on the rich cluster Klemola 44. The exposure times were usually of 60 minutes divided into two exposures for optimal cosmic-ray elimination. Three or four fibres were used during each exposure to monitor the sky spectrum, while a shorter sky exposure was observed right after each object exposure, offsetting the telescope 1 minute north. In Figure 2a, b we present two partly reduced spectra of faint galaxies in the field of Klemola 44. The sky has not yet been subtracted but its contribution in these spectra is mainly confined to the emission lines. An estimate of the accuracy with which the sky can be subtracted will have to wait for a complete reduction of our data.

The average S/N ratio in the blue-visual continuum of the spectra is around 25: with such a value the rms error on the redshift cross-correlation measurement is expected to be better than 30 km/sec. Therefore it appears that OPTOPUS with the new prototype head is already a well suited instrument for redshift surveys down to at least bj = 19–19.5.

These magnitudes are integral values for the entire galaxies which extend beyond the finite aperture of the fibres. The real fluxes collected by OPTOPUS depend on the surface brightness distribution of the objects. For point-like sources like QSOs it will certainly be possible to reach fainter limits. If we consider also that a further improvement (of the order of 10%) will come from the introduction of the F/6 collimator, we can foresee that the updated version of the OPTOPUS facility will really be one of the most efficient facilities of this kind.

It is also interesting to relate about the "mechanical" efficiency of the system, i.e. the rate of fields observable per night. We observed with 25 independent starplates during 5 actual nights of observations. This can be considered as an upper limit, as the level of technical support to this test run was particularly qualified.

A normal changeover of the starplate takes around 30 minutes. A complete exposure run of a starplate, including mounting, alignment, calibrations, flats, 30 min sky exposure and 1 h scientific exposure, takes around 130 minutes.

An OPTOPUS run at La Silla is a demanding task because of the many operations the observer is involved in: the checking of the starplates, the mounting of them in the special adaptor, the positioning of the fibres in the holes, the alignment on the field in the sky and the monitoring of the resulting CCD spectra.

All these operations have to be done accurately but quickly if you want to maximize your observing time. At times the work becomes frantic and the observer is usually exhausted at the end of a run. However, the effort is well rewarded, if one considers that we collected some 700 galaxy spectra in 5 nights! A similar number of spectra with single-object spectroscopy would have required around 50 nights!

In conclusion, it can be said that the test run with the new OPTOPUS prototype head has been very successful. First, it has shown that the partial modifications introduced in the instrument so far have already improved its efficiency. On the other hand, it has also clearly demonstrated that a large-scale survey of galaxy redshifts down to magnitudes as faint as 19 is possible, not only in the dreams of cosmologists, but is really feasible now, with the instruments we already have.

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Optics and Grisms of EFOSC2

In the *Messenger* No. 52 the construction of a second EFOSC for the 2.2-m telescope was announced. Mechanically, EFOSC2 is virtually a copy of EFOSC but comparison of the optical data (see Table 1) shows considerable differences which for some programmes will make EFOSC2 the preferred instrument, even if it is mounted on a smaller telescope.

The optics were completed by the end of 1988 and measured in the ESO optical laboratory. The transmission of the optics is shown in Figure 1. Compared with EFOSC, the transmission has been improved by a reduction in the