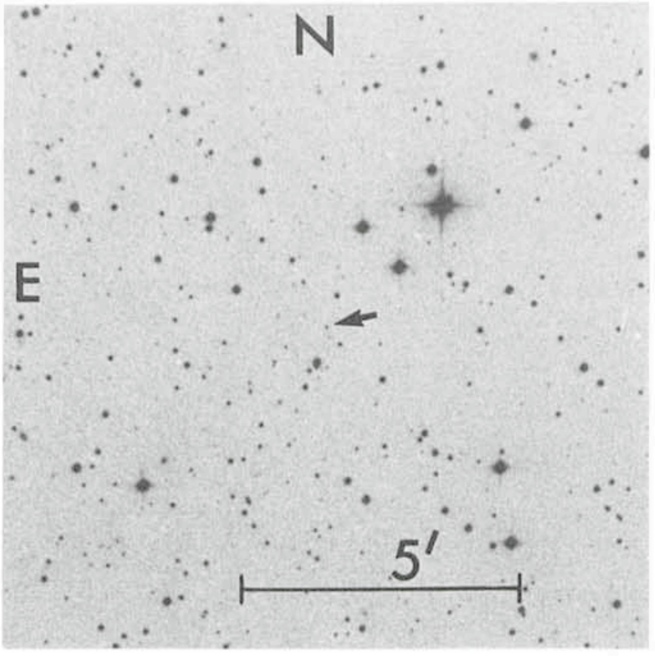

Fig. 1: *Finding chart of the QSO from the ESO Red Sky Survey plate No. 206.*

magnitude is V = 18.5. This object is not listed in the updated Catalogue of Quasars and Active Nuclei by Véron and Véron (1984, *ESO Scientific Report,* No. 1) and as far as we can say is a new high redshift QSO with Z = 3.09. In fact in our very low dispersion spectrum we interpreted the Lyα + NV and CIV

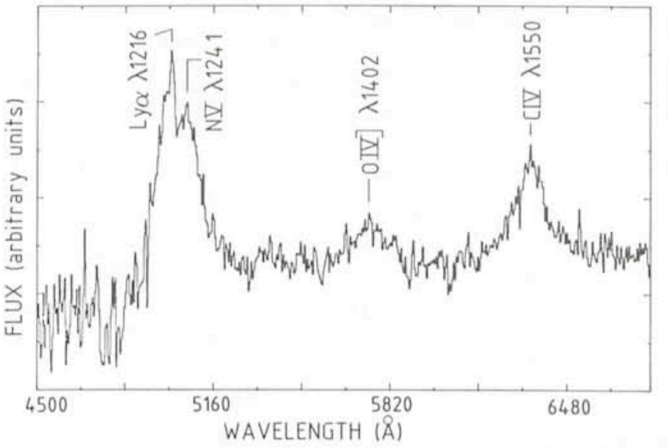

Fig. 2: *Spectrum of the high-redshift QSO obtained with the ESO 3.6 m telescope using the Boller and Chivens spectrograph and a CCD camera. The resolution is 8 Å (FWHM) and the integration time 1 hour.*

λ1550 emission lines as being the continuum on both sides of the λ5165 molecular Swan C_2 band.

Are we lucky or unlucky? We were looking for Wolf-Rayet stars and we found carbon stars; now we are looking for carbon stars and we have found a new high-redshift quasar!

Acknowledgement

I wish to thank P. Angebault for helping me in the reduction of the CCD data.

Circumstellar Shells in the Large Magellanic Cloud

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The brightest stars are known to lose mass at a considerable rate. The most spectacular mass-loss characteristics are exhibited by emission-line stars which are known as P Cyg stars, S Dor variables or as η Car-like objects. It is obvious that these stars are surrounded by circumstellar matter since they have strong emission-lines in their spectra. However, to detect this matter by direct photography may not be easy, but of great interest.

A number of Of and WR stars are known to be surrounded by ring nebulae, several of them in the Large Magellanic Cloud (LMC) (see e.g. Chu and Lasker [1980]). These nebulae have linear diameters of about 20–200 pc. They are probably formed by the interaction between stellar ejecta and the ambient interstellar medium. A few emission-line objects are associated with nebulae of much smaller linear diameter (~1 pc) which probably consist mainly of stellar ejecta. These are the nebulae which we want to discuss here.

A well-known example is the nebulous shell surrounding η Car. It is regarded as the remnant of a great outburst of the star in the last century. Recently Davidson et al. (1984) found a strong overabundance of nitrogen in some knots in the shell which shows that the matter has been processed in the star. That means that the nebula consists of stellar ejecta and not of swept-up interstellar matter. Another case of a nebula surrounding an emission-line supergiant is the shell around the S Dor variable AG Car which was detected by Thackeray (1950).

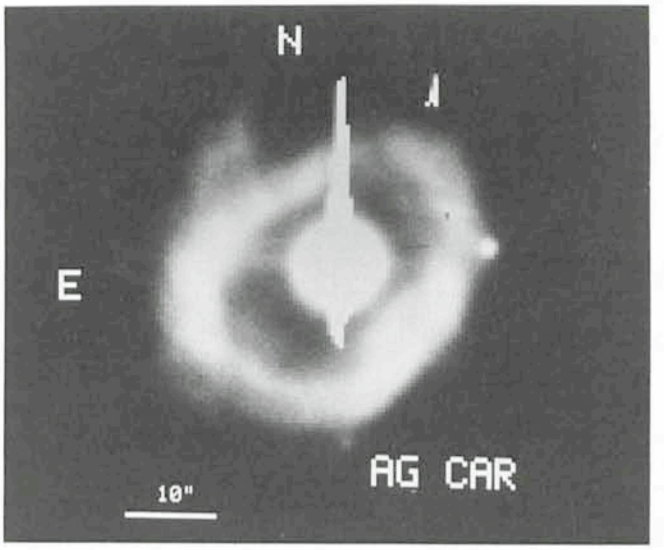

Fig. 1: *CCD image of the ring nebula surrounding the galactic S Dor variable AG Car. A 20 Å wide H_α filter has been used. The exposure time was 30 minutes in a cloudy night. The filamentary structure of the shell can be well seen. The spikes north and south of the central star are not jets but due to charge overflow from the overexposed stellar image. The feature at the northwestern boundary of the nebula is a defect on the CCD.*

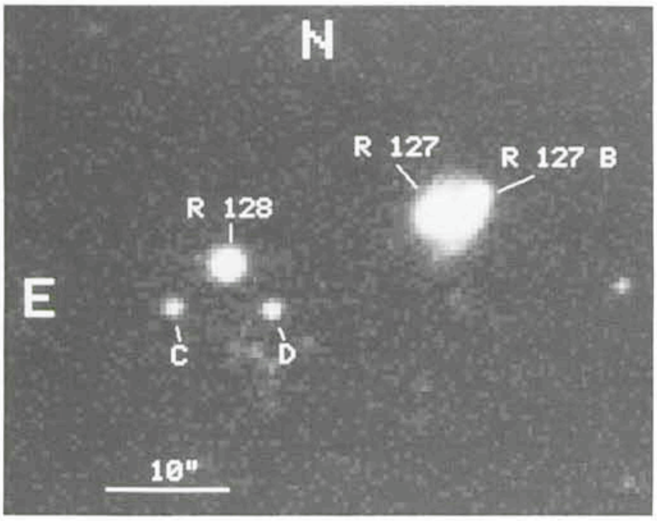

Fig. 2: *CCD image of the field around the S Dor variable R 127 in the LMC. The exposure time was 10 minutes through a 20 Å wide H_α filter. The close companion at a distance of 3 arcsecs – R 127 B – is well separated. The seeing was 1.2 arcsec (FWHM). R 127 appears slightly extended.*

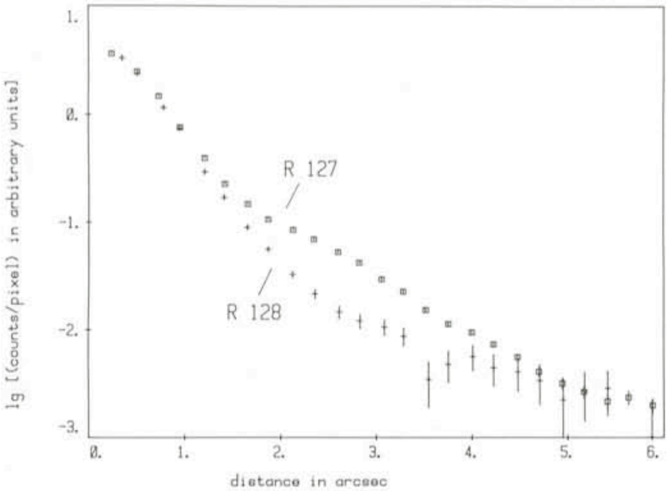

Fig. 5: *Radial brightness profile of R 127 and R 128 as determined from the image shown in Fig. 4. The curve of R 128 has been shifted in order to match the profile of R 127 at the centre. The image of R 127 shows clear evidence for extended structures at distances between 1.5 and 4 arcsecs from the centre of the seeing disk. It is, however, not sure if all of this extension is due to a nebulosity. Part of it may be due to unresolved stars.*

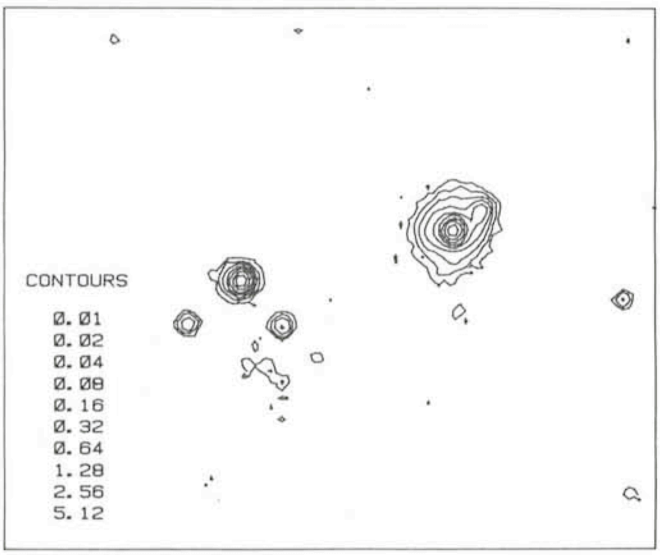

Fig. 3: *An isocontour representation of the field shown in Fig. 2. Note especially the extended structures around R 127.*

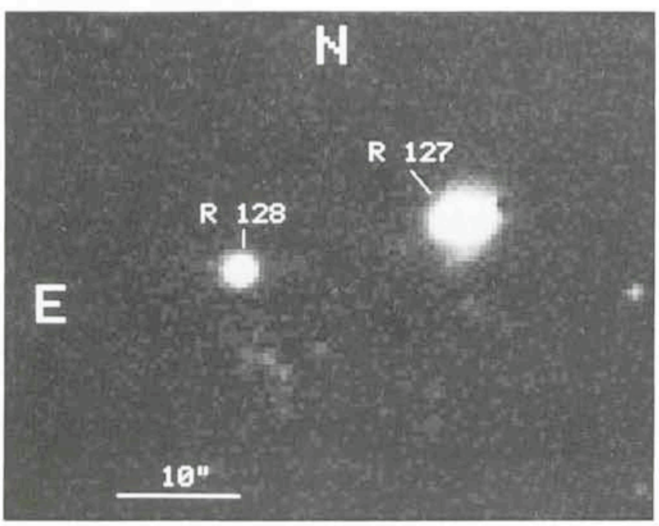

Fig. 4: *Same as Fig. 2 but R 127 B and the two companions of R 128, marked as C and D in Fig. 2, have been removed.*

This ring nebula is shown in Fig. 1. In fact, apart from AG Car and η Car there are only very few luminous emission-line stars where such nebulae have been found. Other P Cyg stars in the Galaxy – among them P Cyg itself – have been searched for nebulae, most of them with negative result. When we realized that objects similar to the shell around AG Car should be detectable at the distance of the LMC, we decided to look for similar nebulae in the LMC since there are many luminous emission-line stars of different types found in this neighbouring galaxy. From the investigation of the nebulae we expected to learn something about the mass-loss history of the central stars. In addition, we hoped to get some information about element abundances which are much easier to obtain from nebular lines than from the spectra of the central stars. All this is important for the determination of the evolutionary status of these stars.

However, there are problems. The estimated size of about 1 pc corresponds to only 4 arcsecs at the distance of the LMC, i.e. we have to find a faint nebulosity close to a relatively bright star, typically of magnitude 11. This is only possible if we analyse the image profiles in detail. Such an analysis can only be done with some hope of success if we use a linear detector with a reasonably high dynamic range, such as a CCD. The dynamic range (i.e. the ratio of the strongest to the faintest detectable signal) of a CCD is restricted by two effects. First, every pixel can hold only a limited number of electrons, very roughly 100,000. If a pixel is overexposed, this will result in a charge overflow along a column. This effect can be seen in the image of AG Car, shown in Fig. 1. The results of a charge overflow are of course disastrous if you are looking for small-scale structures. The second effect which limits the dynamic range of a CCD is the noise produced during the read-out process. It corresponds to about 100 electrons per pixel. The dynamic range of a CCD is thus of the Order of 1,000. This means that twe cannot detect nebulae with a surface brightness more than 1,000 times fainter than the seeing disk of the star at its centre. Therefore, it is necessary to use narrow-band filters centred on nebular emission lines to reduce the contribution from the star as far as possible. We wanted to derive the excitation of the nebulae from photographs taken with different filters. We applied for observing time at the Danish

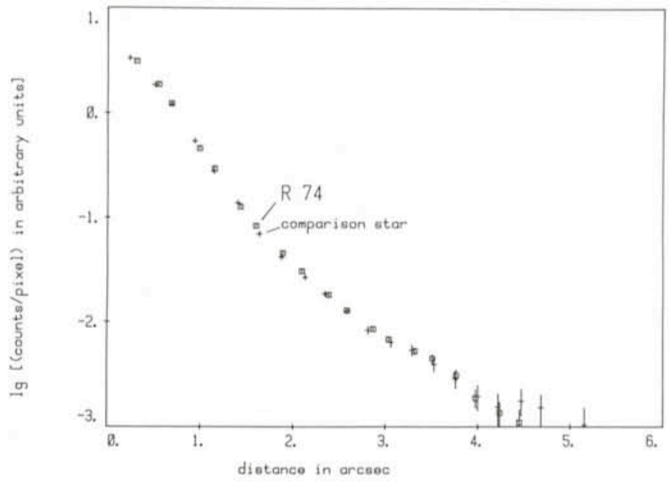

Fig. 6: *Radial brightness profiles of R 74 and a nearby comparison star. The seeing was 1.2 arcsec (FWHM), as in Fig. 4. The profile of the image of R 74 shows no significant deviations from the profile of the comparison star which is supposed to be the point-spread function, i.e. the profile of a point source.*

1.5 m telescope, and 3 nights in January 1984 were allotted to this project.

The weather at La Silla is known to be excellent in January with 90 % of photometric nights. This means that about 3 nights in January are not photometric. Unfortunately, it happened that we got these 3 nights; therefore, a calibration of the images was not possible. So we decided to take photographs in one filter – H_α – only, since a determination of line ratios was not possible. In addition, it was a matter of good luck to get properly exposed images, with all these clouds passing. Therefore, we obtained much less useful data than we had anticipated. Useful data of 15 stars have been recorded, but the exposure levels of several pictures is far from ideal.

The analysis of the data is illustrated in Figs. 2, 3, 4 and 5. Fig. 2 shows the field around the S Dor variable R 127 after subtraction of the electronic bias and flat-field correction. Fig. 3 shows the same field in the form of an isocontour plot. In the next step we cleaned the surroundings of the star and an appropriate comparison star – in this case R 128 – from nearby stars by subtracting a properly scaled and centred stellar profile. The cleaned image is shown in Fig. 4. Finally, we determined the radial brightness profile of the star and the comparison star in order to look for a possible extension of the stellar image. The results for R 127 and R 128 are shown in Fig. 5. The curve of R 128 has been shifted to match R 127 in the inner parts. There is a pronounced difference in the two profiles between about 1.5 and 4 arcsecs which we identify with a nebula surrounding R 127.

R 127 has received much interest in recent years. Walborn (1982) described the spectrum as intermediate between Of and WN stars and found velocity-doubled nebular lines. Stahl et al. (1983) detected an S Dor-type outburst of the star, which was also reported in the *Messenger* (Wolf and Stahl, 1983). In addition, Stahl et al. detected nebular emission lines in R 127 B which gave evidence for a spatially resolved emission-line region. Very recently, Lund and Ferlet (1984) reported broad NaI D absorption-line features which they ascribed to an old, cool, ejected shell. It may well be that it is this shell which we see on our direct photographs. Assuming that the nebula is expanding with the velocity indicated by the NaI D absorptions and using a radius of 3 arcsecs, we estimate a kinematic age of about 15,000 years for the nebula around the star.

On most of our other photographs we see little evidence for nebulosities around the stars. As an example we show in Fig. 5 the data for the P Cyg star R 74. We have found, however, extended structures around a few more stars (although in no case as obvious as in the case of R 127). But in these cases it is not clear if the extension of the images is due to a nebula or to nearby unresolved stars. As usual, more observations are needed.

We thank the ESO staff for technical assistance. Comments from Claus Leitherer on the manuscript are gratefully acknowledged.

References

Chu, Y.-H., Lasker, B.M.: 1980, *Publ. Astron. Soc. Pacific* **92,** 730.
Davidson, K., Dufour, R.J., Walborn, N.R., Gull, T.R.: 1984, IAU Symp. No. 105, Reidel, eds. A. Maeder and A. Renzini, p. 261.
Lund, G., Ferlet, R.: 1984, *The Messenger,* No. **36,** 2.
Stahl, O., Wolf, B., Klare, G., Cassatella, A., Krautter, J., Persi, P., Ferrari-Toniolo, M.: 1983, *Astronomy and Astrophysics* **127,** 49.
Thackeray, A.D.: 1950, *Monthly Notices of the Royal Astronomical Society* **110,** 524.
Walborn, N.R.: 1982, *Astrophysical Journal* **256,** 452.
Wolf, B., Stahl, O.: *The Messenger,* No. **33,** 11.

A Possible Nonlinearity in IDS Data

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I. Introduction

Most of the users of the Image Dissector Scanners mounted on the Boller & Chivens Cassegrain spectrographs on La Silla will be aware of the high count rate nonlinearity of the IDS. The typical figure for this saturation effect is a 10 per cent loss at count rates in excess of some 2,000 detected events per channel per second. For a linear dispersion of 1.7 Å per channel (171 Å per mm grating) this corresponds to a 10 mag star at the 3.6 m and an 8 mag star at the 1.5 m telescopes. In the following I will report on another nonlinearity effect present at very low light levels, i.e. for count rates below 100 counts per second and channel, and discuss some of the possible sources and implications.

II. The Observed Nonlinearity

During the process of the analysis and interpretation of a large number of high signal-to-noise IDS spectra of H II regions I have been confronted with the inconsistency of observed values and theoretical predictions for emission line ratios. The line ratios concerned are: [O III] λ5007 versus λ4959, [N II] λ6583 versus λ6548 and the Balmer series from Hα to H12. The two forbidden line ratios are expected to lie around 2.9 (see for example the compilation of C. Mendoza in "Planetary Nebulae", IAU Symposium No. 103, ed. D.R. Flower, p. 143 [1983]). My own data and those of other ESO observers are centred around 3.15 with a sigma of 0.1. It is clear that errors in the reddening corrections, flat fielding and response calibra-