about 1977 R 127 had been a well classified O star. In 1982 it was discovered that R 127 had developed an S Dor type envelope which resulted in a considerably higher visual brightness. During the past two years this envelope has become even more pronounced and R 127 has now become the second brightest star in the LMC. As m_v is still increasing, R 127 may soon become the visually brightest star of this galaxy.

As described by Wolf and Stahl in the article quoted above, on IUE high resolution spectrograms the envelope absorption lines and P Cygni absorption components of R 127 showed a complex multiple structure, indicating discrete mass loss events. As illustrated by Fig. 5 with CASPEC it has now become possible to observe these features also in many additional lines in the visual spectral range. These observations will certainly help to clarify the nature of this phenomenon and the mass loss mechanism of the S Dor stars in general.

A final example of the potential of CASPEC observations is presented in Fig. 7, where we give sections of two CASPEC spectrograms of the star S Doradus itself, obtained at different epochs. During the past 13 years S Dor has been in its maximum state. However, in August 1983 its visual brightness started to decrease again (cf. Fig. 6) and it seems now to be on its way towards its minimum state. Fortunately, just before the star began to dim significantly, a first CASPEC spectrum of S Dor could be obtained while the instrument was still being tested at the telescope. Recently (13 months later and after the star had become fainter by $\Delta m_v \approx 0.8$) the second spectrum was obtained.

As shown by Fig. 7 the brightness changes are accompanied by characteristic spectral changes: With decreasing visual brightness (i.e. decreasing wind density) the (blue-shifted) envelope absorption features decrease rapidly, some envelope lines (like the Ti II lines) simply disappear, while the Balmer emission, the low density forbidden lines, and the unshifted high excitation "photospheric lines" (like He I λ 4388) increase in strength. Although some of this behaviour was known before, only the high spectral resolution and linearity of CASPEC allows to determine these changes without distortions. Even a slight decrease of the resolution would result in a partial fill-in of the deep envelope absorption components of H_γ by the adjacent very strong emission component.

Most of the data described above have been obtained only very recently and this paper resulted from our excitement during a first quick look at the reduced spectrograms. But we are convinced that the usefulness of the combination of high resolution spectrograms obtained with IUE and CASPEC will become even more evident when all our data are fully analyzed. We also note that the potential of such coordinated space and ground-based spectroscopic programmes will become even greater when the Space Telescope and future UV satellites allow high resolution UV observations of astronomical objects which are beyond the limiting magnitude of the IUE.

Catching Carbon Stars in the Baade's Windows

M. Azzopardi, ESO, J. Lequeux and E. Rebeirot, Observatoire de Marseille

Near-infrared objective prism surveys at low dispersion (1700 to 3400 Å mm^{-1}) using Schmidt telescopes have been extensively used to detect M-, S- and C-type stars in the galactic equatorial zone, and in other strategically selected regions of the Milky Way. The detection techniques have been perfected by Nassau and his associates (Nassau and Velghe, 1964, *Astrophysical Journal* **139,** 190) during their survey, at Cleveland, of the northern part of the Milky Way. These techniques are based on the identification of a number of typical molecular bands (TiO, CN, LaO, VO) that fall in the 6800–8800 Å spectral range, and which are used to classify M-, S- and C-type stars (Mavridis, 1967, Coll. on Late Type Stars, p. 420). Using the same method, partial or entire near-infrared surveys of the southern Milky Way have been carried out by Blanco and Münch (1955, *Bol. Obs. Tonantzintla y Tacubaya* **12,** 273) at Tonantzintla, Smith and Smith (1956, *Astronomical Journal* **61,** 273) at Bloemfontein, and later by Westerlund (1971, *Astronomy and Astrophysics Suppl.* **4,** 51; 1978, ibid. 32, 401) with the Uppsala Schmidt telescope at Mount Stromlo Observatory.

These near-infrared, low dispersion spectra surveys allowed the space distribution of the most recognizable red stars to be studied. These stars are essentially all S stars, or M and C stars later than M2 and C2. It is important to note that the observed distributions are affected by biases due to inhomogeneities in the interstellar absorption and to luminosity differences amongst the various types of stars. Also, the limiting magnitude to which the various red stars can be classified, and thus identified, varies according to their type: in particular, C stars can be detected almost to the limiting magnitude of the plates. Because they are rather luminous – all C and S stars and the majority of the M stars are giants – and less affected by the interstellar absorption in the near-infrared, the red giant stars lead to deep surveys of our Galaxy. The study of the distribution of the C stars as a function of the galactic latitude shows that these stars, which are strongly concentrated in the galactic plane, form the coolest component of the galactic disk population. Local variations in the distribution of the carbon stars with galactic longitude are due to known dark clouds. Nevertheless, it is possible to assert that C stars are inclined to cluster and are correlated with the spiral structure. Their number decreases strongly toward the galactic centre while the number of the late-type M stars increases (Westerlund, 1964, IAU Symp. No. 20, 160).

The three fields selected by Baade (1963, *Evolution of Stars and Galaxies,* p. 277) in the Sagittarius Star Cloud as relatively low absorption regions – currently named NGC 6522 ($l = 0^\circ\!.9$; $b = -3^\circ\!.9$), Sgr I ($l = 1^\circ\!.4$; $b = -2^\circ\!.6$), Sgr II ($l = 4^\circ\!.2$; $b = -5^\circ\!.1$) – allow this trend to be confirmed. A first attempt to identify red giant stars in the galactic nuclear bulge, namely in the clear region near the globular cluster NGC 6522, known as Baade's window, was made by Nassau and Blanco (1958, *Astrophysical Journal* **128,** 46). Owing to the unfavourable scale of the Schmidt telescope used to prospect so crowded a region, they found numerous late-type M stars. McCarthy (1983, *Mem. Soc. Astron. Ital.* **54,** 65) reports that a new near-infrared survey of this region was carried out by Blanco and Hoag as early as 1975 with the grism technique (Bowen and Vaughan, 1973, *Publ. Astron. Soc. Pacific* **85,** 174) at the prime focus of the CTIO 4 m telescope. Using this observational material (region of 0.12 square degree) Blanco et al. (1978, IAU Symp. No. 80, p. 33) found about 300 M stars later than M5 and just one C star. More recently, a preliminary survey by McCarthy and Meier (see McCarthy, 1983) of the Sgr I Baade's window

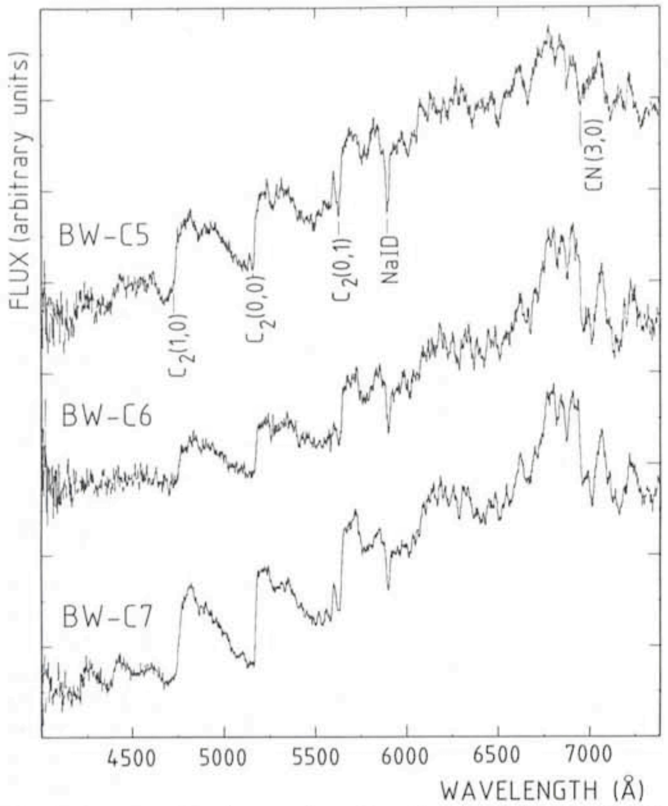

Fig. 1: *Spectra of the three carbon stars identified in the NGC 6522 Baade's window obtained with the ESO 3.6 m telescope using the Boller and Chivens spectrograph and IDS detector. The resolution is 16 Å (FWHM) and the integration time 30 minutes for each.*

resulted in the identification of about 700 late-type M stars and one probable C star in a field of 0.12 square degree, confirming the paucity of carbon stars in the galactic nucleus. In fact, McCarthy (1984, *Bull. Am. Astron. Soc.* **16,** 494) and Blanco et al. (1984, *Astronomical Journal* **89,** 636) now retract the presence of any carbon star in the NGC 6522 and Sgr I Baade's windows.

We have been using for some time another technique for searching for carbon stars: instead of working in the near-infrared spectral range, we use grism and grens devices in the blue-green spectral domain. Carbon stars are identified via their strong Swan bands of the C_2 molecule, mainly those with heads at 4737 Å, 5165 Å and 5635 Å. The greater strength of these bands compared to that of the CN bands in the near-infrared more than compensates for the fainter flux of the C stars, which are very red. From such observations at the 3.6 m telescopes of ESO and CFH Corporation we have discovered many new carbon stars in the Small Magellanic Cloud (SMC) and in nearby spheroidal galaxies, doubling the number of these stars known in the latter objects (Azzopardi and Westerlund, 1984, *The Messenger* **36,** 12). It is important to note that the C stars detected with this method are generally fainter and bluer than those found by the more conventional near-infrared surveys.

Last July we observed the three Baade's windows quoted above, with the CFH 3.6 m telescope using the green grens and the triplet corrector at the prime focus. The dispersion is 2000 Å mm^{-1} and the useful field about 1 square degree. We restricted the spectral range towards the short wavelengths with a Schott GG 435 filter while the range towards the long ones is limited by the cut-off of the hypersensitized IIIa-J emulsion we used (Breysacher and Lequeux, 1983, *The Messenger* **33,** 21). The selected spectral range (4350–5300 Å) makes the C_2 bands at 4737 Å and especially at 5165 Å available for the identification of the C stars. The spectra are very short and thus image overlapping is not a major problem, even in very crowded fields such as those found in the SMC bar or in the galactic centre.

After a careful examination of the plates with a binocular microscope, we discovered 9 C star candidates near NGC 6522, 4 in the Sgr I region and 2 in the Sgr II one as well as other interesting objects whose nature is not yet clear and needs to be found out. Soon after this, we were lucky enough to have an observing run at the ESO 3.6 m telescope with the Boller and Chivens spectrograph and the Image Dissector Scanner (IDS) giving a dispersion of 171 Å mm^{-1}. After some difficulties with bad weather and power failures, we succeeded in observing three candidates during the beginning of the nights of September 26 and 27. All three, located in the NGC 6522 Baade's window, are without doubt carbon stars (Fig. 1). One of these stars (BW-C6) lies in the field studied by Blanco et al. (1984, *Astronomical Journal* **81,** 636). Fig. 2 is an identification chart of star BW-C6. B and V magnitudes as well as B-V colours can be estimated from the IDS spectra. The V magnitudes of the confirmed C stars range between 15.8 and 16.7 and their apparent B-V colours are between 2.0 and 2.5 magnitudes, which is rather blue for carbon stars. The reddening estimate by Arp (1965, *Astrophysical Journal* **141,** 43) for NGC 6522 is E(B-V) = 0.46 mag. ± 0.03 but the interstellar absorption is uneven in Baade's window and the colour excesses of our three C stars might be even larger, making them among the bluest of the known carbon stars. Their luminosity ($M_V \gtrsim -1.5$) is also relatively low.

The interpretation of our discovery is not straightforward. The galactic bulge is a mixture of stellar populations of various ages and metallicities and we do not yet know to which component the newly detected C stars belong. They may also be close binaries in which one of the components has been enriched in carbon transferred from the other, evolved component (see Aaronson and Mould, 1984, Steward Obs. preprint No. 544). Much further work is necessary to get a full understanding of these interesting objects.

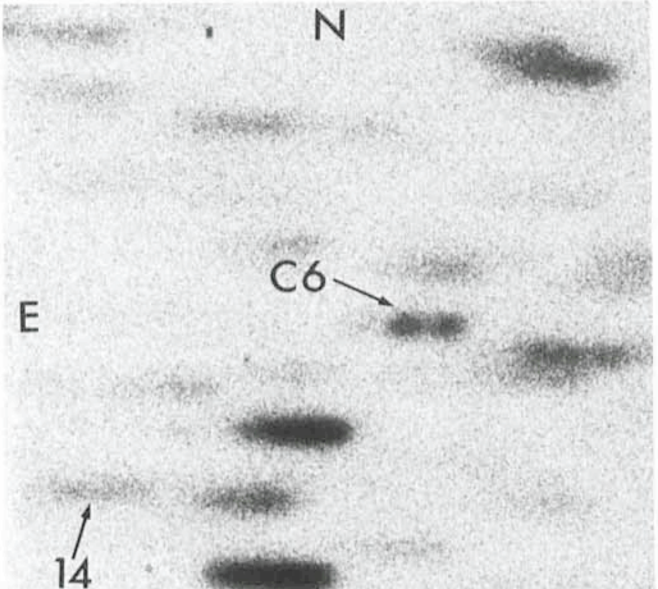

Fig. 2: *Finding chart for carbon star C6 detected in the NGC 6522 Baade's window. The late giant M star No. 14 from Blanco et al. (1984,* Astronomical Journal **89,** *636) is indicated to ease the identification of the discovered C star. Copy of a part of a CFH 3.6 m telescope grens plate (forming gas baked IIIa-J emulsion; 20-minute exposure).*