WOLF-RAYET STARS IN THE MAGELLANIC CLOUDS

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1. INTRODUCTION

Up to now 4 WR stars were known in the SMC (Breysacher and Westerlund, 1978) and 76 in the LMC (Fehrenbach et al., 1976). Because no systematic search for WR stars in the SMC had ever been made, a survey was carried out with the ESO Objective Prism Astrograph which resulted in the identification of 4 new WR stars of the WN type, afterwards confirmed by slit spectroscopy. In the LMC, two fields were also observed and 13 new faint WR stars detected. The results presented here mainly concern the SMC WR stars.

2. OBSERVATIONS

The survey was done at La Silla, Chile, in October 1977, with the 40 cm Objective Prism Astrograph (Fehrenbach et al., 1964) using an interference filter centered at λ4650 (pass band 120 Å). WR stars show up strongly in this spectral region due to the emission mainly from either λ4650 C III (WC) or λ4686 He II (WN). This detection technique, described in detail by Azzopardi and Breysacher (1978) enables, by reducing the background fog and the number of overlapping images, to study very crowded regions.

The present survey (limiting magnitude of m_{pg} 16.5) covered the Bar and the Wing of the SMC. In the LMC, the two fields observed, each 85' in diameter, were centered on stars Sk -68°82 and Sk -69°243 (Sanduleak, 1969). IIa - O nitrogen baked plates were used.

For the newly discovered WR stars, spectrogrammes at 114 Å mm^{-1} were obtained with the Boller and Chivens Cassegrain spectrograph equipped with a Carnegie image-tube at the ESO 3.6 m telescope.

3. RESULTS

Table 1 lists the data concerning the 8 WR stars now known in the SMC. These data are taken from the paper by Azzopardi and Breysacher (1978)

P. S. Conti and C. W. H. de Loore (eds.), Mass Loss and Evolution of O-Type Stars, 51–54.

in which identifications of the stars can be found. The absolute magnitudes were calculated adopting the value of 19.2 as absorption-free distance modulus of the SMC (Westerlund, 1974).

TABLE 1

Wolf-Rayet Stars in the Small Magellanic Cloud

SMC/AB	$\alpha\{1975.0\}\delta$	Spectral type	V_{pg}	E_{B-V}	M_V
1	$0^h42^m.80$ -73°37'1	WN3 + OB	15.48	0.050	-3.9
2	0 47.63 -73 23.7	WN4.5 + O4	14.43	0.088	-5.0
3	0 49.12 -73 30.2	WN3-4 + O4	14.55	0.055	-4.8
4	0 49.87 -73 35.1	WN4.5 + O4-6 V-III	13.43	0.067	-6.0
5	0 58.62 -72 17.9	WN3p + OB	11.88	0.054	-7.5
6	1 02.62 -72 14.7	WN3 + O7 Ia	12.36	0.092	-7.1
7	1 02.78 -72 11.4	WN3p: + OB	13.16	0.092	-6.3
8	1 30.6 -73 33	WC4 ? + O4	12.97	-	-6.:

4. DISCUSSION

All the SMC WR stars studied show direct or indirect evidence of having an OB-type star companion. Direct meaning that absorption lines are indeed seen in the spectra and indirect that the binarity is inferred from both the strength of the continuum relatively to the emission features and the absolute magnitude. For SMC/AB 1,2,3 the absolute magnitudes determined using $(m-M)_\bullet = 19.2$ are hardly compatible with the absolute magnitude calibrations for WR and OB stars (Smith, 1973; Walborn, 1972) and it is suggested that these 3 WR binaries, located in the same region of the SMC are, in fact, seen at a considerable depth into the Cloud.

Considering now the distribution amongst the WR subclasses, Smith (1968, 1973) noted the complete absence of subclasses WC 6-9 and probably WN 6 from the LMC. In the SMC only subclasses WN 3-4.5 are present with, in the WC sequence, one doubtfully (Breysacher and Westerlund, 1978) extreme Wolf-Rayet of type WC 4. Then, except for subclass WC 5 which possibly escaped our detection due to the employed technique (width of the λ4650 emission feature comparable in this case to the filter pass band) no WR stars belonging to subclasses WC 6-9 seem to exist in the SMC. It is also remarkable that no "transition" WN 7 stars (Conti, 1975) are found in the SMC.

After the present survey the census of the WR population in the Small Cloud can probably be considered as quite complete, at least within the survey limits.

It appears that the number of SMC WR stars is small and that their distribution amongst the WR subclasses is different from those of the LMC and the Galaxy. This is possibly related to the differences in chemical abundances, the SMC being known for its metal deficiency.

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DISCUSSION FOLLOWING BREYSACHER AND AZZOPARDI

Conti: I consider this a very interesting result. The fact that the SMC WR stars are all early WNs, and furthermore they all appear to be binaries in telling us something very important. One question: Is the WR classification biased by the fact that the O star dominates the spectrum?

Breysacher: No, because in most of the cases the λλ4604-4620 N V emission feature is visible above the continuum and can effectively be used for the classification. For the two "peculiar" WR stars of Table 1 the situation is slightly different. In both cases, the spectra are characterized by a broad λ4686 He II feature which is dominant, a strong continuum but no visible absorption lines. One of the stars, SMC/AB 5 shows spectral variations and the WN 3 type is inferred from the sometimes detected λλ4604-4620 N V feature.

Crampton: Peter, what fraction of WN3, 4, 5 stars in the Galaxy are binaries? Since WN3, 4, 5's are less luminous than the later types, the O stars will tend to dominate the spectrum more in these cases.

Conti: The actual numbers, which I have recently collected, come from the Smith catalogue as follows (early WN:WN3, 4, 5); Galaxy 7 single, 5 double (42% binaries); LMC 8 single, 4 double (33% binaries). These are detected companions, i.e., the absorption lines are observed. This is very different, apparently, from the SMC where all are double (so far).

Parsons: The Skylab S-019 UV spectra for 6 WN and 6 WC (Galactic) stars showed almost all to be double, with C IV absorption and diluted emission lines indicating an O companion.

Underhill: Is there any "confusion" problem in the spectra of these WR stars? Could there be close multiple systems in which an O star is also observed spectroscopically? Such close systems are quite common in the Galaxy.

Breysacher: The spectral classifications given in Table 1 are based on slit spectra obtained afterwards and not on the spectra recorded on the objective prism plates.

Underhill: Yes, but the slit has a finite size. Might not optical companions be included?

Breysacher: Perhaps, but while guiding the stars onto the slit, no companions were seen.

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