BINARY WOLF-RAYET STARS

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ABSTRACT. The distribution of the WR cluster members is interpreted in terms of their association with the galactic spiral-arm pattern. It is suggested that in a limited volume the number fraction of WR binaries is influenced more by magnetic field properties of the spiral arms, than by function of the galactocentric distance.

INTRODUCTION

There is strong evidence that WR stars evolve from WNL to WC, through mass loss of single massive stars (Maeder, 1987; van der Hucht et al., 1988). A controlling factor of the WR population in galaxies is metallicity (Smith, 1988). This factor also causes variation in the subtype distribution of WR stars (van der Hucht et al., 1988).

Paczynski (1967) for the first time recognized the importance of mass exchange in a close-binary as a channel for producing WR star. This channel, in contrast with single star mode of WR formation, is found to be independent of metallicity (Maeder, 1982).

The binary percentage in the solar neighborhood is on the average 37% (van der Hucht et al., 1988), 29% in LMC (Breysacher, 1980) and perhaps 100% in SMC. A percentage of 50% would be quite normal. It is therefore interesting to look for other evidence for the cause of binary WR production, in the case of high percentages.

THE DATA

Lundstrom and Stenholm (1984) show that ∿30% of the known galactic WR stars are clusters and associations members. Van der Hucht et al. (1988) indicate that eleven of the 43 WR cluster and association members are double-line spectroscopic binaries and thus form a significant fraction.

In order to find a local galactic environment that may affect the formation of binary WR stars, the galactocentric distribution of the clusters and their relationship with the WR subtypes and their binaries are reexamined. By isolating the factor of metallicity, one may be able to deduce other galactic environment parameters which are operating to produce binary WR star. For this purpose 17 clusters within 2.5 kpc from the sun (up to 3 kpc the number is 24) are studied. In this limited volume we expect a uniform metallicity. Within 2.5 kpc from the sun, we are essentially dealing with only 2 branches of galactic spiral arms, namely the Local and the Sagittarius and Carina arms (Bok, 1983). All the clusters under discussion are found in these arms. The age spread of the clusters in $d < 2.5$ kpc is limited within $6.0 \leq \log T \leq 6.7$ yr. This may indicate that the clusters have similar physical characteristics.

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RESULTS AND CONCLUSIONS

It is found that WN 7 stars in clusters are more abundant than earlier WN and WC subtypes. This can be attributed to the age of the sample clusters, which favour WN types - as these stars have not had enough time to evolve into later evolutionary phases yet. The overall pattern of the distribution of WR subclasses as a function of distance from the clusters's centers similar to that obtained by Lundstrom and Stenholm (1984), but there exist an unexplained feature if one breaks down the data into WN and WC populations. Here the WN 6 and 7 stars, which are more massive than other subtypes, are found at larger distances from the clusters centres as compared to the earlier, presumably less massive, subtypes.

Table I shows the breakdown of the number of WR stars which belong to the Local arm and the Sagittarius arm. It can be seen that the number ratio of WR binaries to WR stars in the Local arm is larger (4/7) than in the Sagittarius arm (2/8). Since the clusters are at the same galactocentric distance, the different number ratios should be attributed to another parameter than metallicity. A different IMF may be the cause (Conti et al., 1983; Garmany, 1984). While this could perhaps explain the excess in WN stars in the Sagittarius arm (6) over that in the Local Arm (3), it is unclear how it could account for the fraction of binaries.

Table 1. Clusters in the Local and Sagittarius Arms having WR stars

Type	Local		Sagittarius	
	N	$N_{bin.}$	N	$N_{bin.}$
WN	3	2	6	1
WC/WO	4	2	2	1

Zinneker (1982) proposed a hypothesis that the fraction of binary systems may depend on the local strength of the mean interstellar magnetic field. Therefore the difference in the binary frequency in clusters, which are associated with two different galactic arms, but are at rather similar galactocentric distance may be attributed to the difference of magnetic properties in the two arms.

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