EMISSION LINE RATIO CLASSIFICATION OF SYMBIOTIC STARS.

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ABSTRACT. A 2-dimensional classification system for symbiotic stars based on the 5007/4861 and 3727/5007 line ratios adapted from the method of Baldwin et al.(1981) is presented. It is shown that a simple measurement suffices to classify stars and no reddening has to be taken into account. Symbiotics fall into 2 distinct classes in the line ratio plot. The dusty and S types. Neither type coincides with either the planetary nebulae or the HII region locus. The highest excitation is found for the dusty types. The two dimensional distribution can be interpreted as evolutionary, the more evolved Mira containing symbiotics lying closer to the PN locus. The fact that there are few D, D' type symbiotics would indicate that the phase between Mira and PN is short.

1. INTRODUCTION

Symbiotic stars are generally considered to consist of a cool (super)giant primary and a white dwarf or main sequence star companion. Both stars are embedded in a common envelope of hot, partially ionised gas and or dust. Their spectra are dominated by strong emission lines (both permitted and forbidden) of H, He, O, N and other elements and usually show a red continuum with TiO absorption bands.

Webster and Allen(1975) have classsified symbiotics into three types on the basis of IR photometry. S types show a normal photospheric continuum while D and D' types show respectively a hot and cool dust excess in the IR. A catalogue of about 140 symbiotics has been published by Allen(1984) which also contains the optical spectra of about 100 of these stars. Our knowledge of these stars is far from complete and any classification scheme which can shed some light on the symbiotic phenomenon is useful. Here such a scheme is presented.

J. Mikolajewska et al. (eds.), The Symbiotic Phenomenon, 123–125.

2. EMISSION LINE CLASSIFICATION.

A two dimensional classification of emission line objects has been published by Baldwin, Phillips and Terlevich(1981) (BPT). In their plot, the PN and HII regions occupy two well defined and distinct loci.

In a recent paper, Gutierrez-Moreno et al.(1986)(GMMC) apply the scheme of BPT to two symbiotics. The stars fall between the HII region and PN loci. Since a number of PN are inside the HII region locus, the significance of the position of the two stars is not clear. A larger sample of symbiotics would indicate if these stars occupy a special place in the BPT diagram and if different types of symbiotic star occupy different loci.

In this paper a large sample of symbiotics is used in a simplyfied version of the BPT scheme and it is shown that the emission line classification separates the dusty (D, D') types from the S types.

3. DATA AND RESULTS.

The spectra used for this work are mainly selected from those published by Allen(1984), the two from GMMC and for some 15 stars IDS spectra were obtained by the author at the 1.5m ESO telescope on La Silla, Chile.

Since for most of the stars only the 3727, 4861 and 5007 line fluxes were available, the full BPT scheme could not be used since it needs the 6300, 6563 and 6584 lines too. For a larger proportion of the stars, the 6300 and 6584 lines were available and on the basis of these ratios, it was determined that the 5007/4861 ratio is the most sensitive parameter. It was therefore decided to use this ratio in the BPT diagram in addition to the usual 3 ratio plot which uses the 5007/4861, the 6300/6563 and the 6584/6563 ratios.

Reddening has not been taken into account since the sensitivity to its effects is very low. The effect of de-reddening would be to shift stars to the top right hand corner of the diagram.

In Figure 1 the adapted BPT diagram for 92 stars is shown. Of the 16 D and D' types 1 lies in, 11 lie close to and 4 lie well away from the PN region. There is a clear separation into S types and D, D' types. The 2 stars of GMM are included without their reddening correction.

The full BPT diagram shows the same trend with 13 stars of which the 8 D, D' types are all near the PN locus.

The separation of D, D' types from S types towards the PN locus could indicate an evolutionary trend in the diagram. This would mean that S types evolve into D, D' types and eventually become PN. The scarcity of dusty types indicates a rapid stage of evolution, with D' types perhaps as a "late" D type.

https://doi.org/10.1017/S0252921100103264 Published online by Cambridge University Press

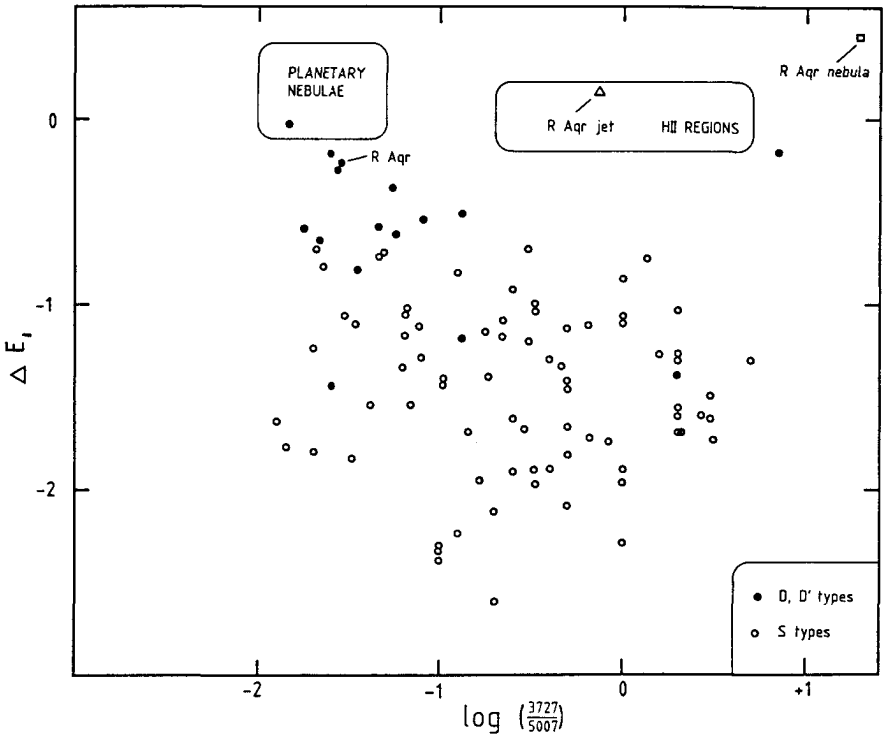

Figure 1 Plot of ΔE_1 (see BPT) against log 3727/5007. Clearly, the S and D types are separated with the D types nearer the PN locus.

This scheme would be the symbiotic equivalent of that for "normal" stars: through a Mira and a short OH/IR stage stars on the upper AGB become PN. A search for OH/IR symbiotics might prove interesting. Also, are there such things as symbiotic PN?

ACKNOWLEDGEMENTS.

My thanks to J.W.Pel, W.Seitter and D.A.Allen for interesting discussions and to Prof.L.Woltjer for his support.

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