ELEMENTAL ABUNDANCES IN SYMBIOTIC STARS

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Symbiotic objects are related to planetary nebulae in that they represent late stages of stellar evolution. They are interacting binary systems where a hot companion star ionizes the stellar wind of a red giant. This configuration offers the unique possibility for deriving elemental abundances for cool giants from a nebular spectrum with the diagnostic tools employed for HII regions. The analysis can be applied to different types of symbiotic systems having a G, K or M giant, a Mira variable or a carbon star as cool component. The great advantage of this technique is, that it does not depend on stellar parameters or molecular data, and that it can therefore be used as a test or an alternative for the traditional photospheric abundance determinations.

When abundances for symbiotic systems are compared with published abundances for cool giants and predictions from stellar evolution calculations we find:
(i) The abundances of the majority of symbiotic systems are typical for cool giants after CN cycle burning and the first dredge up phase. This is in agreement with previous abundance studies on symbiotic systems (Nussbaumer et al. 1988; Schmid & Schild 1990; de Freitas Pacheco & Costa 1992; Schild et al. 1992). Symbiotic Miras have enhanced carbon abundances. This is most likely the result of an ongoing third dredge up phase.
(ii) Strong nitrogen enrichment (N/O > 0.67), similar to type I planetary nebulae is only rarely observed in symbiotic systems (1 out of 32).
(iii) One of the analysed object, AS 210, is a symbiotic carbon Mira. Its relative nitrogen abundance supports the suspicion that in cool carbon stars N is underestimated and needs to be revised (see Lambert et al. 1986).
(iv) For some G type symbiotic systems (e.g. M1-2, HD 330036, AS 201), which are often considered to be young compact planetary nebulae with a binary core, an enhanced carbon abundance is derived. Two explanations are considered for the abundances of this special group. Either the ionized material was ejected form the present hot component (PN interpretation), or the material originates from the cool giant (symbiotic star interpretation). The first interpretation is supported if the abundances in the photosphere of the G giant are different from the abundances seen in the nebula. The latter interpretation implies that the G type giant in these systems must possess an abundance anomaly like a Ba star or an early R type carbon star. The relevant photospheric abundance determinations are still waiting to be done.

References

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