STELLAR EVOLUTION IN THE MAGELLANIC CLOUDS FROM STUDIES OF PLANETARY NEBULAE.

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We present the results of a spectroscopic study of planetary nebulae (PN) in the Magellanic Clouds. The optical survey of He, N, O, and Ne abundances by Monk *et al.* (1988) has been updated by higher S/N AAT optical data. In addition, carbon and other elemental abundances have been derived from the *IUE* spectra of 40 PN. Ionized nebular masses have been derived for 80 PN. The ionised mass versus nebular electron density plot shows that planetary nebulae become optically thin when their electron densities drop below 4500 cm^{-3}. Below this density, the mean nebular hydrogen mass found for non-Type I PN is 0.22 ± 0.08 $M_{\odot}$. Using Zanstra and energy-balance methods, the mean central star mass found for 14 SMC and LMC PN is 0.59 ± 0.02 $M_{\odot}$.

Th optical and UV Spectra of 40 planetary nebulae in the Magellanic Clouds have been analysed to derive abundances for He, C, N, O, Ne, S, Ar, and Si. The nitrogen abundances in the non-Type I nebulae are found to be consistent with the exposure of secondary nitrogen (produced by the CN cycle) by the first dredge-up, with 45% and 100% of the initial carbon having been converted to nitrogen in the LMC and SMC, respectively. All of the non-Type I PN have C/O ratios significantly larger than unity, consistent with the exposure of primary carbon by the third dredge-up. The carbon enhancements are largest in the SMC, the galaxy with the lower metallicity. The upper limit to the central star luminosities, $L \approx 8000$ $L_{\odot}$, is similar to the observed upper limit to Carbon star luminosities in the LMC (Reid 1989).

Most of the Type I PN have C/O ratios below unity, which together with their high N abundances suggests that they mixed out freshly produced ^{12}C which was then converted to ^{14}N via 'deep envelope mixing'. There is some evidence for neon over-enhancements in the Type I PN, likely to be a result of the reactions $^{14}N(\alpha,\gamma)^{18}F(\alpha,\gamma)^{22}Ne$ in the He-burning zone during thermal pulses occurring in the late AGB evolutionary stage of the star.

We confirm the standard picture wherein a typical red giant of 1.3 $M_{\odot}$ produces a degenerate remnant with a core of 0.6 $M_{\odot}$, a surrounding nebula of 0.3 $M_{\odot}$ (now seen as a PN), and thus loses some 0.4 $M_{\odot}$ during earlier stages in its red giant evolution.

Full results of this work are to presented in Walton *et al.* (1991).

References

Monk, D. J., Barlow, M. J. & Clegg, R. E. S., 1988. *Mon. not. R. astr. Soc.*, **234**, 583.
Reid, N, 1989. *Astrophys. Sp. Sci.*, 156, 73.
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