ABUNDANCES AND NEBULAR AND CENTRAL STAR MASSES FOR MAGELLANIC CLOUD PLANETARY NEBULAE.

N.A. WALTON, M.J. BARLOW, & D.J. MONK
Department of Physics & Astronomy
University College London
Gower Street, London WC1E 6BT

R.E.S. CLEGG
Royal Greenwich Observatory
Madingley Road
Cambridge CB3 0EZ

ABSTRACT: 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 38 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 $0.22 \pm 0.08\ M_{\odot}$. Using Zanstra and energy-balance methods, the mean central star mass found for 14 SMC and LMC PN is $0.59 \pm 0.02\ M_{\odot}$.

IUE and *AAT* spectra of 38 planetary nebulae in the Magellanic Clouds have been analysed to derive ionic and total elemental abundances for a range of species. Our results are summarised in Tables 1 and 2 of Barlow (1990). 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 50% 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 five LMC Type I PN (those with N/O>0.5) were found to have the same mean oxygen abundance as found for the non-Type I PN and H II regions in the LMC, implying that no large ON-cycle depletion of oxygen resulted from the second dredge-up. From a comparison of the N and C+N abundances in the LMC Type I nebulae with those in LMC H II regions, it is concluded that the third dredge-up plus envelope-burning (which converted some of the dredged-up carbon to nitrogen) occurred in the Type I progenitor stars. Fig. 1 shows that two of the five LMC Type I nebulae have C/O>1. The Ne/O ratio is found to be enhanced in LMC Type I PN by 0.19 ± 0.03 dex relative to LMC non-Type I PN and H II regions.

Ionized nebular hydrogen masses have been derived for 80 Magellanic Cloud PN using dereddened Hβ fluxes and accurate [O II] 3726,29 Å doublet ratio electron densities. A plot of ionized hydrogen mass versus nebular electron density indicates that the expanding PN become optically thin when their electron densities drop below 4500 cm^{-3}. Table 1 summarises the mean hydrogen masses found for SMC and LMC PN over a number of density ranges. The mean nebular hydrogen mass found for non-Type I PN is the same in the SMC and LMC and equal to $0.217 \pm 0.077\ M_{\odot}$.

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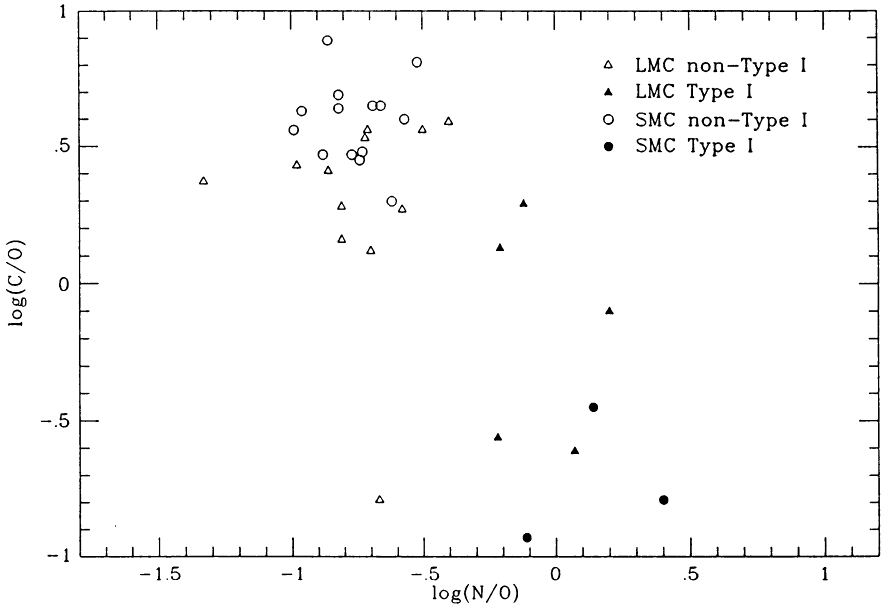

Figure 1: The relationship between log(C/O) and log(N/O) for the sample of Magellanic Cloud planetary nebulae.

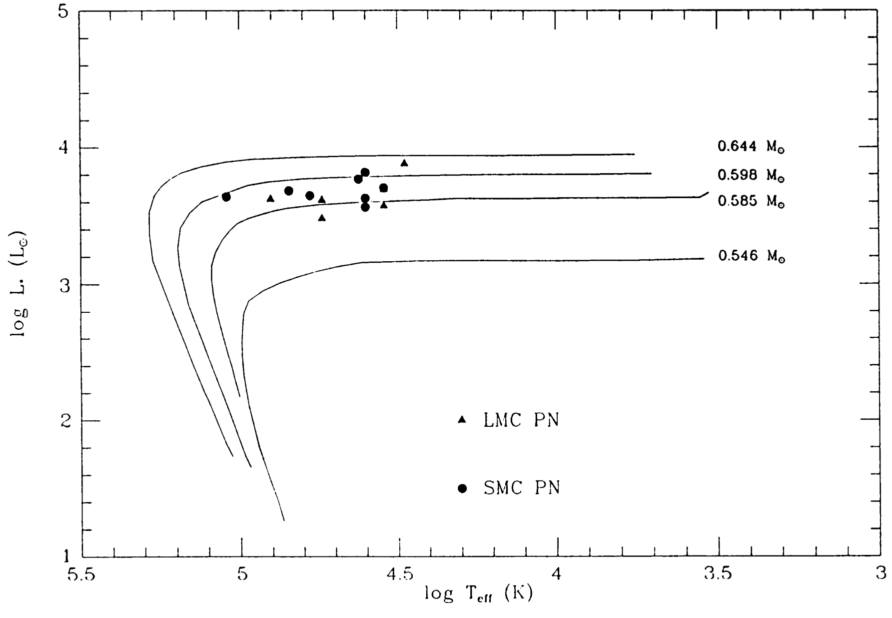

Figure 2: The central stars of a number of the Magellanic Cloud planetary nebulae are shown plotted on an H-R diagram. Schoenberner evolutionary tracks for central stars having a range of core masses are also plotted.

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Table 1: Ionized Hydrogen Masses

	PN Sample	Electron Density (cm^{-3})	Mean Ionized Hydrogen Mass ($M_\odot$)
7	SMC non-Type I	< 2500	0.214 ± 0.099
7	SMC non-Type I	$2500 < n_e < 4500$	0.220 ± 0.045
15	SMC non-Type I	< 4500	0.217 ± 0.079
9	LMC non-Type I	< 2500	0.217 ± 0.084
11	LMC non-Type I	$2500 < n_e < 4500$	0.217 ± 0.067
20	LMC non-Type I	< 4500	0.217 ± 0.075
35	Total non-Type I	< 4500	0.217 ± 0.077
3	SMC Type I	< 4500	0.280 ± 0.062
7	LMC Type I	< 4500	0.359 ± 0.093

The adopted distance moduli are: LMC $18^{m}_{\cdot}35$ and SMC $18^{m}_{\cdot}8$

From optical and ultraviolet spectra, we have derived central star effective temperatures, surface gravities and masses using the Zanstra and energy-balance methods. Fig. 2 shows our results for 14 central stars, plotted on an H-R diagram along with a number of theoretical evolutionary tracks for a range of core masses. The central star mass distribution is found to be very narrow. The mean mass found for all 14 central stars is 0.585 ± 0.016 $M_\odot$; the eight SMC central stars give 0.587 ± 0.013 $M_\odot$ and the six LMC central stars give 0.583 ± 0.020 $M_\odot$.

References

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