parallel NLTE models.

Our results do not provide confirmation for evidence of absorption by $H_2^+$, discussed by Heap and Stecher (1980).

## AN OPTICAL AND ULTRAVIOLET STUDY OF NINE LOW-EXCITATION PLANETARY NEBULAE

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Ultraviolet and optical observations of seven very low excitation nebulae (He 2-131, He 2-138, TC 1, M 1-11, M 1-12, M 1-26, H 2-1) and of two low-excitation nebulae (IC 418 and He 2-108) are discussed.

The very low excitation (VLE) objects are classed as having I([OIII] λ 5007)/I(Hβ) < 1, while the two low-excitation objects have [OIII]/Hβ < 2. No HeII emission lines are seen. Electron temperatures and densities are determined from forbidden line ratios. A nebular density gradient is inferred for He 2-108 and H 2-1. The C/O ratio is determined for IC 418, He 2-131 and TC 1; upper limits on C/O are obtained for He 2-138 and He 2-108.

IC 418, which has C/O > 1 (Harrington et al., 1980), is known to show SiC in emission between 10 and 12 μm. We have no UV data on M 1-11 which also shows SiC in emission. However He 2-108, He 2-131, He 2-138 and TC 1 all have C/O < 1, consistent with the infrared data which indicate silicate emission from the three that have been observed.

The reddening constant c(Hβ) is deduced from the λ 2200 interstellar absorption feature for six of the objects. In all cases the resultant value is less than that obtained from Radio/Hβ measurements. The discrepancy is particularly large for the case of M 1-26.

The stellar continuum of each object has been examined. Significant line blanketing occurs between 1200 Å and 1900 Å in all of the objects for which we have data. The HI and HeI Zanstra temperatures are found to be grossly inconsistent with the optical and UV colour temperatures when using black-body models, LTE line-blanketed plane-parallel models (Kurucz, 1979), or NLTE plane-parallel models (Mihalas, 1972). By contrast, the optical and UV continuum of IC 418 is well matched by a spherically extended NLTE model atmosphere with $T(\tau = 2/3)$ = 29 700 K and log $g(\tau = 2/3)$ = 2.96 (Model 6 of Kunasz, Hummer and Mihalas, 1975). This model also predicts the observed nebular fluxes in Hβ and HeI λ 5876 to within 15%. It is suggested that cooler extended model atmospheres

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will be required to adequately represent the other objects in our sample.

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## NEBULAR ABUNDANCES AND CENTRAL STAR PARAMETERS FOR EIGHT PN IN THE MAGELLANIC CLOUDS

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We have obtained ultraviolet and optical spectrophotometry for two PN in the SMC (N87, L302) and for six in the LMC (N28, N66, N97, N141, N201, N203). The data were obtained with the IUE (eight nebulae), the 3.9 m AAT (six nebulae) and the 1.9 m SAAO reflector (two nebulae). Nebular temperatures, densities and abundances are presented. The nebular continua were calculated and subtracted from the observed continua, allowing the central star energy distributions and hydrogen and helium Zanstra temperatures to be derived. Our results for the effective temperatures and absolute magnitudes and luminosities of the central stars are presented, including data on two Wolf-Rayet central stars (WC5 and WC8) and one Of central star.

The 1150-2000 Å spectrum of LMC N97 is extremely rich and includes lines of SiII, SiIII] and FeIII. The overall spectrum appears to be a counterpart to that of the bipolar nebula NGC 6302 with, for example, significant amounts of nitrogen present in all stages from NI to NV. We find $T_e$(OIII) = 20,000 K, $T_e$(NII, SII, OII) = 13,000 K and $N_e$(SII, OII) = 2.6 x $10^3$ $cm^{-3}$. The helium abundance, N(He)/N(H) = 0.18, agrees with that found by Osmer (1976) and is the same as that found by Aller et al. (1981) for NGC 6302. The heavy elements in N97 have about half the abundance relative to H compared to NGC 6302. We find for N97: N/H = 4(-4), O/H = 2.5(-4), C/H = 4(-5), Ne/H = 5.7(-5).

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