MEAN ELECTRON DENSITIES, DISTANCES AND FILLING FACTORS FOR GALACTIC PLANETARY NEBULAE

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ABSTRACT: Mean electron densities are presented for over 100 planetary nebulae (PN). Distances to the majority of these PN are then derived, based on calibrations from observations of Magellanic Cloud PN. Absolute radii and filling factors have also been determined. A trend is seen in that for larger radii, smaller filling factors are found, however we show that such a trend results from uncertainties in the observed angular diameters.

We present [O II] 3726, 3729 Å doublet ratios and electron densities for ~120 galactic planetary nebulae. For ~100 of the objects, the doublet ratios represent integrations over the whole of the nebula which were obtained via trailed spectrograph exposures. Additionally, we present integrated [S II] 6716, 6731 Å doublet ratios and electron densities for 63 southern galactic PN. We find that the densities derived from the integrated [O II] and [S II] doublet ratios are in excellent agreement with each other.

Distances have been derived for the majority of the nebulae, using calibrations recently derived from Magellanic Cloud PN. For PN which are optically thin in the hydrogen Lyman continuum, we have derived distances using a variant of the Shklovsky method (constant ionized hydrogen mass) which uses the mean [O II] electron density and the measured radio flux and which does not require knowledge of the filling factor or nebular angular radius. For PN which are optically thick in the Lyman continuum, the constant Hβ flux method was used to derive distances. The typical [O II] density at the transition point between an optically thick and thin nebula is 4400 cm^{-3}. Since the optically thin and thick methods both overestimate the distance when applied to inappropriate nebulae, the smaller of the two distance estimates is adopted for each nebula.

An extensive comparison is made between the distances derived here and previously published distances and distance scales. It is shown that the present distances, based on Magellanic Cloud calibrations, give consistency with independent distance estimates. They also yield much greater self-consistency between central star masses derived from luminosity versus T_{eff} comparisons on the one hand, and from absolute magnitude versus evolutionary age comparisons on the other hand.

For the PN in our sample, rms electron densities, filling factors and absolute radii have also been derived. The derived filling factors are found to decrease with increasing absolute angular radius, but we argue that this effect can be attributed to the effects of measurement uncertainties in the adopted angular radii.

This work is fully presented in Kingsburgh & Barlow (1992, MNRAS 257,317) and Kingsburgh & English (1992, MNRAS, in press).

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