7

PNe Conclusions

7.1 Angular diameters

I have calculated angular diameters for 69 PNe by deconvolving the point spread function of field stars from Gaussian FWHM profiles. A correction factor, γ, was applied to determine the true diameter. γ was approximated by a simple analytic function and diameters were calculated using two models: a constant emissivity shell 0.8, $\theta_{\rm shell}$, and photoionization line emission, $\theta_{\rm line}$. I present the mean value derived from the two models, $\theta_{\rm mean}$, as my best estimate. For some objects the low intensity contour plots revealed an elliptical structure that was not always apparent from the FWHM measurements. Axis averaged mean angular diameters of fully resolved objects ranged from 2.8 ± 0.1 to 12.7 ± 1.2 arc seconds. 18 Hα images were restored with the Richardson-Lucy algorithm and restored diameters tended to be around one arc second smaller below 4 arc seconds.

7.2 Fluxes

The total flux detected through the filters was calculated for 70 PNe. Doppler shifted Hα, [O III] (and [N II]) wavelengths observed at the telescope were computed from radial velocities, and filter transmission coefficients applied to arrive at actual flux den-

sities. For Hα and [O III] there is little evidence of any systematic differences between observed and catalogued flux values. The accuracy of filter response data was considered the most significant source of error and estimated at between ±5 to ±10 per cent.

7.3 Extinction

Observed Hα extinction in the direction of the Bulge was determined using the radio to Hβ flux ratio, the expected to observed Hβ flux ratio and the Balmer-line intensity ratio, giving an expression in terms of observed Hα flux and catalogue radio flux. Catalogue Hα extinction values were also derived from catalogued Hα and Hβ flux values in terms of the fundamental extinction law A_λ/A_V by means of an R_V dependent function. I compared observed and catalogue extinction values for a subset of Bulge objects and found that values determined from observed Hα flux and catalogued radio flux tended to be lower than those calculated with $R_V = 3.1$ and catalogue Hα and Hβ fluxes. A method for determining R_V was derived in terms of observed extinction and catalogued Hβ and Hα flux values. I found R_V to be highly sensitive to differences between observed and catalogue extinction values. There also appears to be a correlation between increasing values of both R_V and observed Hα extinction, which is in agreement with the findings of STAS discussed above. Estimating a reasonable error in R_V, I find observed $\langle R_V \rangle = 2.0$, which fits within the range calculated by Udalski (2003) and agrees with his conclusion that toward the Bulge interstellar extinction is steeper than $R_V = 3.1$. Using catalogue Hα and S_ν flux values I find good agreement, with $\langle R_{\mathrm{V\,cat}} \rangle = 2.2$. For one small region in my sample I find $\langle R_V \rangle$ as low as 1.2, which suggests that R_V does indeed vary considerably along different lines of sight. I have shown that my values of R_V can be reproduced using dust models with a turnover radius of 0.08 microns. A lower value of R_V may also be obtained by adding the populations of small carbonaceous grains and PAHs.

7.4 Further work

As mentioned above, values for $R_{\mathrm{V\,cat}}$ and $\Delta R_{\mathrm{V\,cat}}$ were also calculated using catalogue Hα flux values in place of my observed values. The mean catalogue value $\langle R_{\mathrm{V\,cat}} \rangle$ for subset B was found to be 2.2, suggesting that existing catalogue flux values also predict steeper extinction towards the Bulge. An extension of this analysis to a much larger sample of PNe using catalogue Hα/Hβ flux ratios and radio fluxes may well confirm that interstellar extinction toward the Bulge is lower than that corresponding to the standard extinction curve $R_V = 3.1$. In June 2003 I took part in further observations at the NTT of a large additional selection of Bulge PNe, using Hα, Hβ, [N II] and [O III] on- and off-band filters. The analysis of this data (using the same techniques as described herein) has been outside the scope of this work, but should provide additional evidence to establish the extinction curve toward the Bulge.

Whittet (1992) points out that correlated changes in polarisation and extinction curves are to be expected if the polarising grains contribute significantly to visual extinction, and that such a correlation has been observed. These variations are likely to be caused by changes in the size distribution of the grains, so in principle, polarimetry observations towards the Bulge might also be useful in confirming a tendency towards smaller grain sizes, and hence lower extinction (see also Hough 2006).