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ARE ALL ANNULAR PLANETARY NEBULAE REALLY CLOSED SHELLS?

H. Monteiro, R. Gruenwald, C. Morisset, and S. M. Viegas

Instituto Astronomico e Geofísico, USP, Avenida Miguel Stefano, 4200 CEP 04301-904, Sao Paulo, Brazil

To determine the 3-dimensional distribution of matter that produces the observed morphologies in planetary nebulae (PNe) is essential in understanding the gas ejection mechanisms that form these objects, giving also important constraints for stellar evolution theories. Monteiro et al. (2000) showed that ellipsoidal geometry, usually adopted in the literature for the typical annular PN NGC 3132, is not able to consistently reproduce the density and velocity profiles. It was also shown that a Diabolo structure reproduced these aspects. However, in order to obtain a consistent model, more detailed observations are needed. We then performed spatially resolved observations in the 1.6-m telescope of the Laboratorio Nacional de Astrofisica (LNA, Brazil). Using these observations (images, total line intensities, etc.), a 3-dimensional photoionization code and the Diabolo structure, characteristic parameters for the gas and the central star were obtained.

Long-slit spectra were obtained for various positions in the nebula. These exposures are then combined to form an image of the object in any given wavelength. The total emitted flux is then obtained by integrating the image. Fluxes for several lines, relative to Hβ, are listed in Table 1.

A three-dimensional model was obtained for NGC 3132 which reproduces the total line intensities, the general aspects of the line images and in particular the [S II] line intensity ratio (see Fig. 1). This model rules out the ellipsoidal shell as a possible structure for this nebula. As a byproduct, characteristic parameters for the central star were determined: $T_{\rm eff} = 98\,000$ K, $L_\star = 170 L_\odot$ and a distance of 800 pc. The final abundances obtained, relative to H, are: He = 0.126, O = 8.8×10^{-4}, Ne = 6.0×10^{-5}, C = 3.5×10^{-4}, N = 2.2×10^{-4}, S = 1.4×10^{-5} and Ar = 2.9×10^{-6}. The results show that the Diabolo structure is capable of reproducing all the presented characteristics within the uncertainties involved. These results pose important questions for the true 3-dimensional structure of annular-shaped PNe.

TABLE 1

LINE INTENSITIES

λ (Å)	Model	Observed
H I 4861[a]	5.8×10^{-11}	$(7.2 \pm 1.4) \times 10^{-11}$
He I 4471	0.06	0.06 ± 0.01
He II 4686	0.11	0.10 ± 0.03
[O III] 5007	7.13	8.15 ± 1.2
[N I] 5200	0.13	0.10 ± 0.02
[N II] 5755	0.06	0.07 ± 0.02
[O I] 6300	0.33	0.32 ± 0.05
[N II] 6584	4.20	5.28 ± 1.06
[S II] 6718	0.46	0.46 ± 0.07
[S II] 6732	0.41	0.42 ± 0.06

[a]Units: erg cm^{-2} s^{-1}

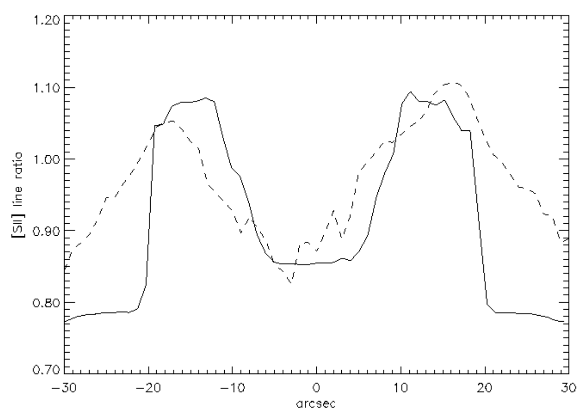

Fig. 1. Compared profiles of observed (dashed line) and model (solid line) [S II] line ratio.

REFERENCES

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