RevMexAA (Serie de Conferencias), **14**, 24–24 (2002)

VLA RADIO CONTINUUM OBSERVATIONS OF WR RING NEBULAE

C. Cappa[1], W.M. Goss[2] and S. Pineault[3]

We report radio continuum observations of the WR ring nebulae around WR 101 and WR 113 obtained with the Very Large Array of the NRAO.[4] The thermal nature of both ring nebulae is confirmed and electron densities and ionized masses are estimated.

The optical ring nebula associated with WR 101 appears as a faint arc of diffuse emission with a major axis of $\approx 11'$ (see Fig. 12, Marston et al. 1994). The nebula was classified as W/E type.

WR 113 belongs to the eclipsing binary system CV Ser. González & Rosado (1984) discovered a double optical structure around the star which consists of an inner ring of $4'$ in radius and an outer arc of radius $9'$. They suggest that the inner ring originated by the action of the stellar wind of the WR star on the surroundings, while the outer arc could have been formed in the first stages of the WR phase or in a phase previous to the WR stage.

The VLA continuum observations were obtained in the DnC array with resolutions of $\simeq$ 38 and 30 arcsec for the fields around WR 101 and WR 113, respectively. *IRAS* images of the nebulae with resolutions better than $2'$ are also analyzed.

These VLA observations enabled us to image in some detail the radio counterpart of the ring nebulae around WR 101 (G357.5–1.4) and WR 113 (G18.8 + 1.8). There is a remarkable resemblance among the optical, infrared and radio images of these ring nebulae.

The interferometric radio data indicate that the nebula around WR 101 is thermal in nature. The ionized mass and electron density of G357.5–1.4 are $\approx 190\pm95$ $M_\odot$ (corrected for filling factor) and 55 cm^{-3}. These results were derived assuming an electron temperature of 10^4 K, 10% abundance of singly ionized He and a distance of 3.2 kpc (van der Hucht 2001). The high resolution *IRAS* images at 60 and 100 μm lead to a mass estimate of $\approx$0.3 $M_\odot$ and a temperature of $\approx$ 40 K for the dust component. The dust temperature is similar to the temperatures derived for bow shocks (Van Buren & McCray 1988). The IR ring nebula associated with WR 101 appears projected onto the northern section of the large *IRAS* shell ($80'$ in diameter) found by Marston (1996) in the direction of the WR star.

The ionized masses and electron densities in the inner and outer structures in G18.8+1.8 are $\approx 20\pm10$ $M_\odot$, 350 cm^{-3} and $\approx 90\pm45$ $M_\odot$ and 40 cm^{-3}, respectively. These values are based on the same assumptions as for the nebula around WR 101. The adopted distance is 2.0 kpc. Both the correlation diagram between brightness temperature at 1465 MHz and its equivalent at 60 μm and the ratio between the brightness at 60 μm and the radio brightness confirm the thermal nature of G18.8+1.8.

These results suggest that G357.5–1.4 (Anon [WR 101]) and the outer arc of G18.8+1.8 (Anon[WR 113]) are compatible with a large contribution of swept-up interstellar gas. The inner shell of G18.8+1.8 may contain a relatively large fraction of expelled WR wind material.

REFERENCES

Gonzalez, J., & Rosado, M. 1984, A&A, 134, L21
van der Hucht, K.A. 2001, New Astronomy Rev., 36, 145
Marston, A.P. 1996, AJ, 112, 2828
Marston, A.P., Yocum, D.R., Garcia-Segura, G., & Chu, Y.-H. 1994, ApJS, 95, 151
Van Buren, D. & McCray, R. 1988, ApJ, 329, L93

[1]Instituto Argentino de Radioastronomía, and FCAGLP, La Plata, Argentina
[2]National Radio Astronomy Observatory, Socorro, USA
[3]Département de Physique et Observatoire du Mont Mégantic, Université Laval, Québec, Canada

[4]The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.