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The nearby structure of the Local Arm

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Abstract. The continuum emission of the galactic region located at G85-0.5 is well defined by the weak 11 *cm* wavelength emission. The region catalogued as W80 is extended 3^o in diameter and the optical images show the North America and the Pelican Nebulae (NPN) complex. In this paper we derive new distances wich were obtained from the radiorecombination line observations made at a frequency near 1.4 GHz. The results suggest that the ionized hydrogen is spread along the line of sight instead of being clumped at one specific distance. We identified three structures located at distances of about 0.7 *kpc*, 1.7 *kpc*, and 2.7 *kpc*, respectively. Using a simple model where we assume homogeneity and a constant electron temperature the electron densities of each structure are obtained. We conclude that W80 is composed of different regions located along the line of sight.

Resumen.
La emisión del continuo de la región galáctica en G85-0.5 está bien definida por las observaciones del continuo en la longitud de onda de 11 cm. La región es catalogada como W80. La misma se extiende 3^o en diámetro y la imagen óptica muestra el complejo de las nebulosas de Norte América y Pelícano. En este artículo se informan las nuevas medidas de distancia obtenidas del análisis de observaciones de lineas de recombinación en la frecuencia de 1.4 GHz. Los resultados sugieren que el hidrógeno ionizado se extiende a lo largo de la linea de la visual en lugar de estar agrupado a una distancia dada. Identificamos tres estructuras localizadas a distancias de 0.7 *kpc*, 1.7 *kpc*, y 2.7 *kpc*, respectivamente. Utilizando un modelo simple, asumiendo homogeneidad y temperatura electrónica constante, se obtiene la densidad electrónica para cada estructura. Concluimos que W80 se compone de diferentes regiones localizadas a lo largo de la linea de la visual.

1. Introduction

The W80 region was studied at decimeter wavelength by Wendker (1968). He suggests that the HII region consists of one extended component of uniform density in which several local electron density enhancements are embedded. Other continuum studies in the region were carried out by Wendker et al. (1983) and they estimate a distance of 500 pc for NPN nebulae. Two supernova remnants (SNRs) G85.4+0.7 and G85.9-0.6, were discovered by Kothes et al (2001) superimposed on W80. Polarization studies made by Uyaniker et al (2003) suggest that the material of W80 depolarizes all extended nonthermal emission generated behind, based on the model of Wendker et al. (1983).
In this work we show the results of the distance measurements obtained from the RRLs observations obtained at 1.4 GHz over the W80 region. The observations were obtained from the galactic plane survey of Heiles et al. (1996) with a beam of 36 arc min; other data were obtained as part of the survey made by Azcárate et al. (1997) using a beam of 30 arc min and the observations of Barcia et al. (1985) with a beam of 20 arc min were also included. All data were obtained with single dish antenna and at the same frequency (1.4 GHz).

2. Procedure

The peak velocity of the profiles were obtained from the gaussian fit of the H166α lines. The distances were obtained by the kinematical method using the peak velocity of the profiles, based on a "flat" rotation curve with $R_o = 8.0$ kpc and $V_o = 220$ kms^{-1} (Reid, 1993). Distance ambiguity from the model occur for positive velocities. Three profiles of the sample have positive velocities, whereas in most cases they are negative velocities.
A total of 21 profiles were analyzed. The summary of the results are shown in Figure 1 where the sample of each observation is shown on the optical image of the Palomar Observatory Sky Survey. It shows the North America and Pelican Nebulae are spatially correlated with the W80 radiosource (Fürst et al., 1990). On Figure 1 the location of three concentrations are identified with two ovals and a circle. The *horizontal oval* indicates the source located at 0.75 $\pm$0.3 kpc. It is projected at the southwest of W80, just at the end of the optical dust filament . The RRLs line emission emerging from this area is probably associated with the optical feature, dubbed "Yucatan peninsula". The *vertical oval* at the west of NPN shows the region where the emission is located between 2.5 and 2.9 kpc. The average velocity of the profiles is v=-5.12$\pm$0.73 kms^{-1}, which corresponds to a distance of 2.7 $\pm$0.2kpc.
The *circle* at the north-west in Figure 1 shows the place where we found the line emission with the maximum negative velocities; it arises at the north of the Pelican nebula with peak velocities of about -9.10$\pm$0.34 kms^{-1}. The flat rotation curve model suggests that the gas is located at a distance of 3.2 $\pm$0.2kpc. This emission is over the galactic plane probably emerging from the continuum spots located at l=84.0, b=+0.5 and l=84.0, b=+0.8 (Fürst et al., 1990) which do not belong to W80.

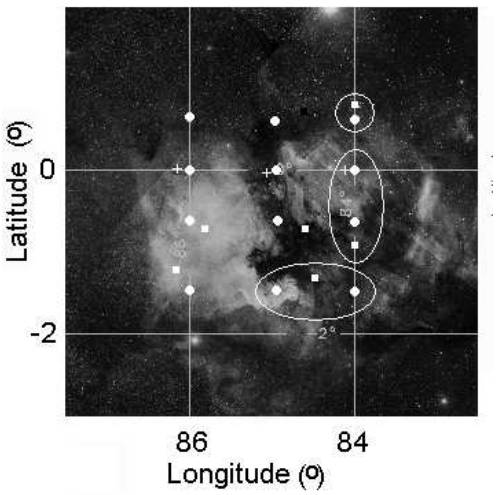

Figure 1. Optical image of the NPN from the POSS. Dots show the target of Azcárate at al. (1997), squares show the target of Heiles et al (1996), and plus signs show the target of Barcia (1985). The lower oval shows the near region located at about 700 *pc*, over the "Yucatan peninsula" which is associated with the dark clouds L935. The vertical oval shows the region where the line velocities suggest a distance larger than 2.7 *kpc*. The circle shows the profiles with high negative velocities from which a distance of 3.2 *kpc* is obtained. The remaining region located over the "USA shape" and the "head of the Pelican" profiles suggest an average distance of 1.7 *kpc*

The emission of the remaining region, projected over the east side of the NPN, has an average velocity of -1.70 ± 1.20 kms^{-1}. This velocity corresponds to a distance of 1.7 ± 0.3 *kpc*. The object is in the line of sight of the optical image which is part of the North America nebula (the ri"USA shape") and on the "head" of the Pelican nebula". If these recombination lines are related to the optical emission, they have to be located at the same distance. Considering that the profiles are located between 1.2 to 2.2 *kpc*, the differences in radial velocities are probably due to internal gradient in distance within this HII region.

3. Results

In Table 1 the results are shown. Column 1 describe the objects, column 2 shows the average velocity and its standard deviation. Columns 3 and 4 show the distance and the size of each region, respectively. Column 5 gives the average emission measure obtained from the profiles assuming the electron temperature T_e =6600 K (Shaver, 1983), and column 6 list the electron density. The spatial correlation between the continuum of W80 and the emission of the RRLs suggest that both emissions arise from the same gas, and also reveal the thermal nature of the region. The W80 region consists of low density ionized gas spread at different distances between 0.7 and 2.7 *kpc*. It further strengthens the hypothesis that the ionized gas of W80 is distributed along the line of sight instead of being clumped at one distance.

Table 1: Parameters of W80 Region

Object location	Av. Velocity (km s^{-1})	D Kpc	S pc	<E> ($cm^{-6}pc$)	$<ne^2>^{0.5}$ (cm^{-3})
horizontal oval	+2.24 ± 0.97	0.7± 0.3	13	1900	12
east region	-1.70 ± 1.20	1.7± 0.2	60	1700	5
vertical oval	-5.12 ± 0.73	2.7 ± 0.2	45	1300	5
circle	-9.10 ± 0.34	3.2 ± 0.3	44	600	4

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