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CARINA OB2 AND ITS SURROUNDING ISM

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RESUMEN

Se presentan los resultados de observaciones realizadas en la transición hiperfina en 21 cm del H I en la región de la asociación Car OB2. Hemos descubierto una notable cavidad de H I en la dirección de la asociación, en un rango de velocidades similares a los de ésta. Esta cavidad se presenta rodeada de una conspicua cáscara en expansión. Mostramos evidencias observacionales que favorecen un vínculo físico entre estos rasgos de H I y la asociación OB. Las estructuras de H I halladas en el medio interestelar podrían ser el resultado de la acción combinada de los vientos y la presión de radiación de las estrellas más jóvenes de Car OB2. También hemos analizado la emisión del CO (115 GHz) en la misma región, hallando una notable contrapartida con la cáscara de H I. El tamaño y los parámetros cinemáticos del gas molecular son muy similares a los del gas atómico.

ABSTRACT

Based on observations of H I 21 cm line, we report the discovery of a huge H I cavity found toward the stellar association Car OB2. This cavity, seen at velocities similar to that of Car OB2, appears surrounded by a striking expanding H I shell. There seems to be a physical link between these H I features and the OB association. The neutral gas structures found in the ISM at 21 cm would be the consequence of the combined action of both stellar winds and radiation pressure from the hottest members of Car OB2. We also analyzed the CO (115 GHz) emission in the same region, finding a notorious counterpart with the H I shell. The size and kinematical parameters of the molecular gas almost mimic those of the atomic gas.

Key words: **ISM: KINEMATICS AND DYNAMICS — ISM: STRUCTURE — OPEN CLUSTERS AND ASSOCIATIONS: INDIVIDUAL (CAR OB2) — RADIO LINES: ISM**

1. BACKGROUND

Carina OB2 $(l, b) \approx (290.^{\circ}0, 0.^{\circ}4)$ is an extended ($\phi \approx 40'$) and rich stellar association located at ≈ 3 kpc from the Sun, in the Sagittarius-Carina arm (García 1993). It is a young association ($4\,10^6$ yr) having almost one hundred early-type stars among its members.

We search for the H I and CO emission in the Car OB2 field aiming to identify the structures formed in the ISM as a result of the interaction between the most massive members of this OB association and their surroundings.

2. OBSERVATIONAL RESULTS

Figure 1 reveals the most representative features of the H I distribution in the field of Car OB2. We note the typical disc-ring structure in the sequence of [position-position] maps. With these maps and a series of [position-velocity] maps we disclosed the expanding nature of the H I structure and derived the observational parameters shown in Table 1. We adopted for the shell the same distance of Car OB2, namely 3.1 kpc.

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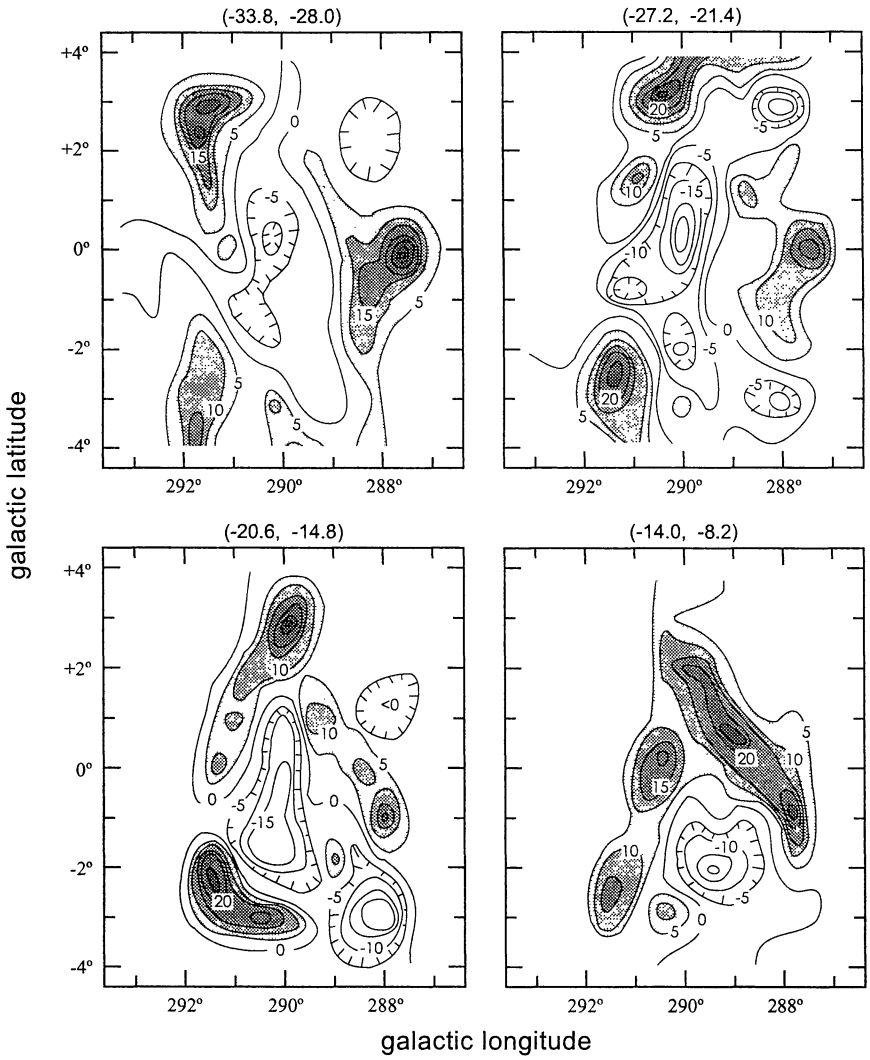

Fig. 1. Distribution of the H I column density in the field of Car OB2. The velocity intervals are indicated at the top of each figure. Contour levels are in units of $10^{19}\,\mathrm{cm}^{-2}$.

TABLE 1

PARAMETERS OF THE CARINA OB2 H I SHELL

Parameter	Unit	
Centroid (l, b)	deg	290°.1, +0°.2
Systemic and expansion velocities	$\mathrm{km\,s}^{-1}$	−27 and 22
Major × minor axis	pc	130 × 80
Total mass	$M_\odot$	$1.5\,10^5$
Kinetic energy	erg	$7.1\,10^{50}$
Expanding momentum	$M_\odot\,\mathrm{km\,s}^{-1}$	$3.2\,10^6$
Characteristic lifetime	yr	$4.1\,10^6$

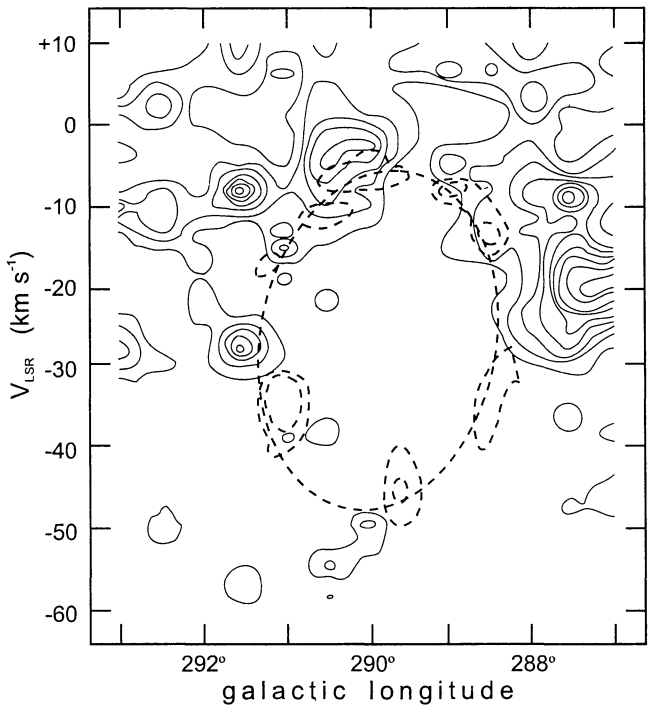

Fig. 2. Galactic longitude-velocity map of the CO in the Car OB2 region. Some H I contours are plotted for comparison as dashed lines.

Analyzing the CO emission in the same area, we have found seven molecular complexes, most of them in good spatial and kinematic correlation with the H I. Figure 2 shows a $[l,V]$ map, integrated over $-0.^{\circ}5 \leq b \leq +0.^{\circ}5$. The distribution of these complexes mimics the ellipsoidal distribution of the expanding H I shell, shown as dashed lines. In consequence, a common origin for both atomic and molecular expanding gas is suggested.

3. ORIGIN OF THE EXPANDING SHELL

We estimated the total amount of mechanical energy and momentum injected into the ISM by the most massive main-sequence members of Car OB2 during their lives, and compared with the expanding kinetic energy and momentum of the shell. The stellar data were taken from García (1993). Individual mass-loss rates and terminal wind velocities were obtained using calibrations and empirical formulae from several authors (Leitherer et al. 1992; Lamers & Leitherer 1993; Vacca et al. 1996). In this way, we determined that the H I shell found around Car OB2 is part of an expanding interstellar bubble observed in its energy-conserving phase. The most massive stars of NGC 3572b and the blue supergiants HD 96248 and HD 96261 may also have played a role in its genesis.

4. SUMMARY

The centroid of the H I void is almost coincident with the optical position of Car OB2. The radial velocity range in which this H I cavity appears is in very good agreement with the mean radial velocity of Car OB2, namely $-33\,\mathrm{km\,s^{-1}}$. The mechanical power injected by the most massive stars of Car OB2 alone, by means of their stellar winds, could be the origin of the observed expanding H I structure.

There is a striking spatial correlation between the atomic gas, as traced by the H I, and the molecular material, as traced by the CO emission. The molecular material depicts both a spatial and kinematical distribution that is in very good agreement with that of the H I.

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