The Environment and Magnetic Field of Cometary Globule CG30

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Abstract. In this work, we combine observations of optical linear polarization (R band), IRAS far-infrared images and radio molecular lines to investigate the cometary globule CG30 (at IRAS Vela Shell). CG30 shows Herbig-Haro objects, molecular outflows, hosts a very young binary star and has a star formation efficiency of about 6% to 17%. Its magnetic field is important to support the CG structure and shows evidence of torsion and compression of the field lines. The quadrupolar outflow of the binary star affects the temperature of the molecular gas, and changes the degree of polarization of the dust grains in the environment of CG30. This work is based on observations collected at LNA/CNPq, Brazil and SEST/ESO, Chile.

INTRODUCTION

CG30 is a cometary globule (small, dense and cold dark clouds with long ionized tails, bright rims and young stellar objects associated) in the IRAS Vela Shell (IVS). The IVS is an interstellar bubble with size of about 130 pc that is 450 pc far-away from the Sun. All cometary globules in this region are located on the surface of an expanding shell. CG30 has associated a Herbig-Haro object (HH120) that has an IRAS point source embedded (IRAS08076-3556) and a reflection nebula associated. The hypothesis that CG30 could be a region with several stars forming has come out with the observations of H2 1-0 (S)1 towards this globule [1]. This hypothesis was confirmed by Hanning et al [2] that observed two dust cores at 850 mm.

MOLECULAR GAS

Molecular rotational lines of CO (J = 2-1 and J = 1-0), ^{13}CO (J = 2-1), C^{18}O (J = 1-0 and J = 2-1), HCN (J = 1-0) and HCO$^+$ (J = 1-0) were observed toward CG30 in 1992 with the Swedish ESO 15 meters telescope (SEST) at La Silla (Chile). This globule was mapped in CO (J = 2-1) and C^{18}O (J = 1-0) lines with 30 arc-second and 1 arc-minute grid spacing, respectively. The other lines were observed only in the center of its head.

This cometary globule has core size of 0.31 by 0.20 pc, C^{18}O column density of 1.03×10^{15} cm^{-2}, and molecular hydrogen density of 10^4 cm^{-3} derived from the HCN observations. The estimated mass in the head of CG30 was 9.3 M⊙ derived from the

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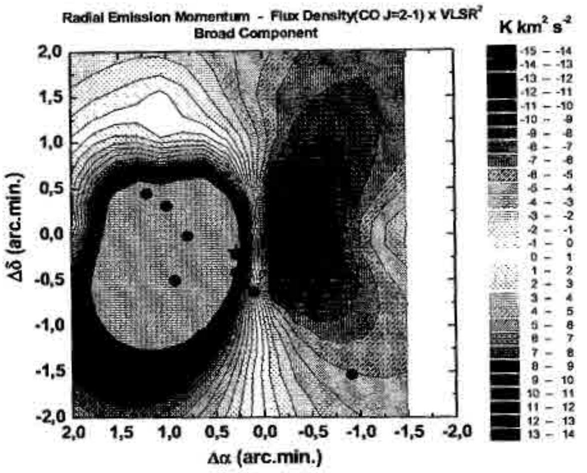

FIGURE 2. CO (J = 2-1) radial momentum. The gray area is a cut of scale in the red lobe (maximum is 100 K·km^2·s^{-2}). The yellow stars show the north and the south components of the young binary star. The green dots show the positions of the H_2 1-0 (S)1 emission regions [1]. The light green ellipses are the emission integrated in the velocity of the core observed in the C^{18}O (J=1-0) line.

THE MAGNETIC FIELD

In order to study the magnetic field towards CG30, we measured the optical linear polarization of the field stars around the cometary globule. The observations were made in 1998 at the Laboratório Nacional de Astrofísica (LNA/CNPq) on Pico dos Dias (Brazil).

We measured about 100 stars with $P/\sigma P > 3$ having magnitudes $R \leq 17$. The average value of the polarization degree in the CG30 field is about 2.7%. The linear polarization of the stars shows one polarization direction parallel to IVS surface and the other parallel to outflow of the north component of binary star. Fig. 3 shows the field observed and a vector represents the linear polarization. Fig. 4 and Fig. 5 present the distributions of polarization degree and polarization angle, respectively.

The Fig. 6 shows the radial and azimuth distributions of polarization degree and polarization angle. These distributions are important to test if there are evidences of compression and torsion [7] of the magnetic field. In this case, both distributions suggest compression and torsion of the magnetic field.

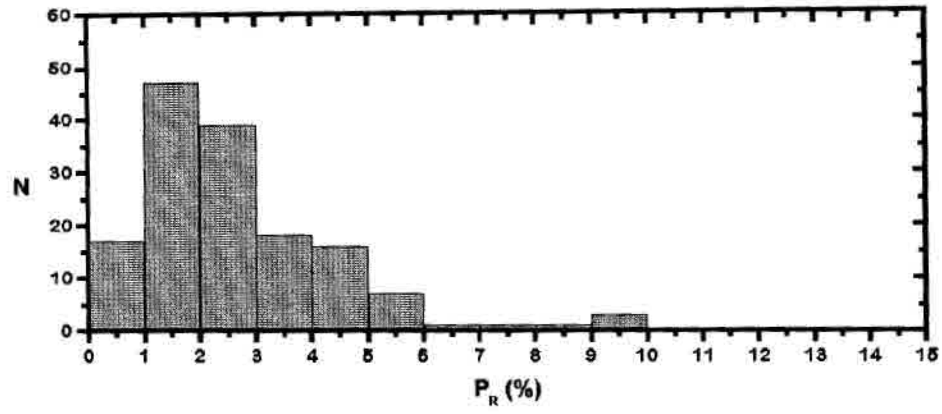

FIGURE 4. Distribution of the polarization degree in the CG30 field.

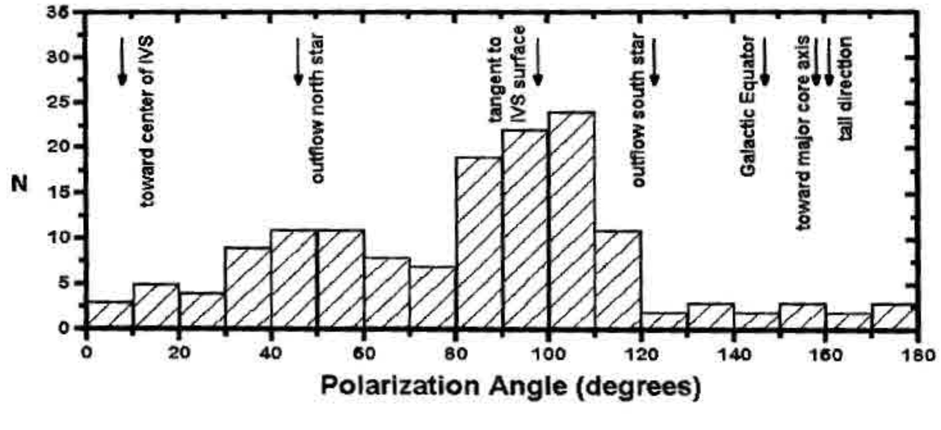

FIGURE 5. Distribution of the polarization angles in the CG30 field. On the top of this figure are given position angles for some important directions associated with CG30 outflow, IVS and the interstellar medium.

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