THE MOLECULAR OBSERVATIONS OF THE CENTRAL PART OF THE S106 MOLECULAR CLOUD

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1. INTRODUCTION

S106 is an optical bipolar nebula which is elongated in the north-south direction. In the center, there is an infrared source and an ultra-compact H II region, indicating that a young, massive star has been just formed. A high resolution VLA map by Bally *et al.* (1983) and Felli *et al.* (1984) revealed a well confined bipolar-shaped H II region with a dust layer in its center. The dust layer which is inclined 25° from the east-west direction is extremely interesting because it seems to indicate that the cold molecular disk is very thin in the central part. A massive molecular core elongated in the east-west direction was observed with CO emission by Bally and Scoville (1982). In the central part, Bieging (1984) reported the detection of a rotating compact disk with HCN emission using the Hat Creek mm-array, which might be a molecular counterpart of the dust layer observed by Bally *et al.* (1983) and Felli *et al.* (1984).

2. OBSERVATIONS AND RESULTS

To check the existence of the compact disk and to obtain more detailed information of the molecular gas distribution in this complex system we have made CO, HCN, HCO^+, and CS observations using the NRO 45-m telescope. The beamwidths, 15" at 115 GHz and 20" at 88 GHz, are comparable to that of Bieging (12" × 16" at 88 GHz).

The resulting distribution of the observed molecular lines are quite similar as shown in Figures 1 and 2. The extended disk component is observed with two intensity maxima in the east and the west of the protostar, in agreement with the previous CO results with a larger beam of 1' (Bally and Scoville 1982). In the central part, the disk component seems to be geometrically thin and the thin molecular layer is parallel to the dust lane. There is a cavity in the north and the south side of the molecular layer elongated toward roughly the north-south direction, which is parallel to that of the bipolar H II region (Figure 1).

The HCN and HCO^+ emission distributions (Figure 2) also show the elongated feature which is parallel to the direction of the dust layer with double peaks in the east and the west side of the IRS. The peak in the east side is stronger and more complex than the west peak as also seen in the CO map. However, no sign of the existence of a compact ro-

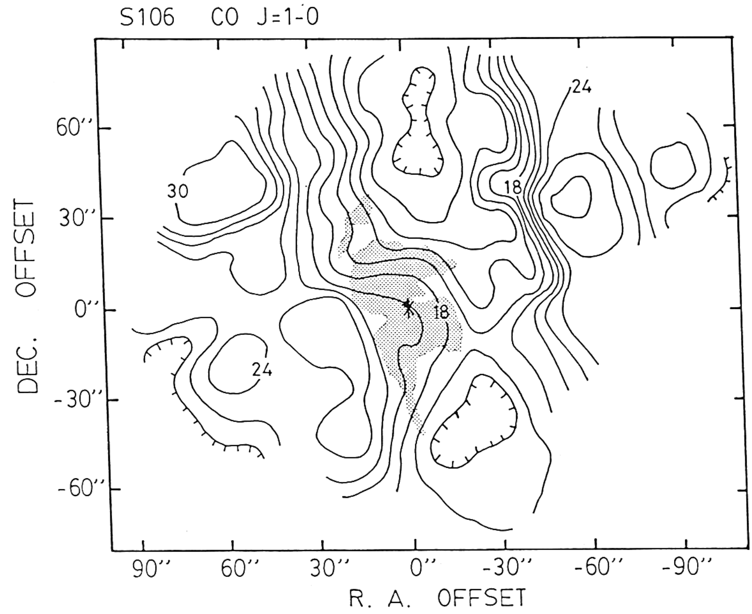

Fig. 1. The intensity distribution of CO J = 1-0 emission integrated over V_{lsr} = -1.5 to -0.5 km s^{-1}. The peak velocity falls in this velocity range almost all over the observed region. The contour intervals are in units of K. The protostar denoted as * mark is the position of the IRS and the ultra-compact H II region. The hatched area is the H II region observed with the VLA (Bally, Snell, and Predmore 1983).

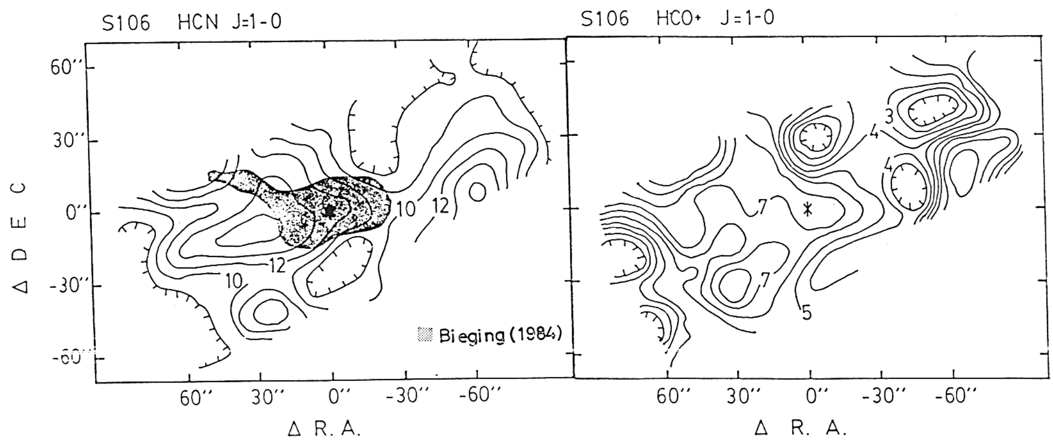

Fig. 2. Distribution of the intensities of HCN (left) and HCO^+ (right) emission integrated over V_{lsr} = -10 to 8 km s^{-1}. Contour intervals are in units of K km s^{-1}. The hatched area is the compact HCN disk reported by Bieging (1984).

tating disk with a 35" diameter reported by Bieging (1984) can be recognized.

We have investigated the position-velocity diagrams and could not find the large, distinct velocity gradient which is expected for the rotating disk repored. There is a complex velocity structure near the IRS, but that is not as large as 2 km s^{-1} $arcsec^{-1}$ which is required for support against the gravitational attraction of the central 20 $M_\odot$ star, nor it shows a simple rigid-rotation like pattern. Instead of the large scale velocity gradient, a narrow blueshifted wing is seen toward the protostar that suggests the existence of a very compact outflow. There are no strong redshifted components and therefore the flow in S106 is probably not of a bipolar-type.

The results from our observations indicate that the protostellar disk around S106 is disrupting, and consequently that S106 is in a late stage of the massive star formation process.

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DIFFRACTION-LIMITED FAR-INFRARED IMAGING OF "PROTOSTARS"

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New mapping and analysis techniques for NASA's Kuiper Airborne Observatory are described which permit us to obtain information of size scales of order 10" in the far-infrared. Basically, the focal-plane image is highly oversampled while the telescope is scanned smoothly and repeatedly over the region of interest with a slit of size λ/D. Maximum-entropy deconvolution is then used to obtain spectral frequency information down to scales of $\sim \lambda/2D$.

We discuss the application of these techniques to the study of dust density and temperature distributions around "protostars", both spherically symmetric sources like S140 and disk-like sources such as S106.