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CLUMPY STRUCTURE IN THE W3 MOLECULAR CORE

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The core region of the W3 molecular cloud has high molecular line luminosities (Dickel *et al.* 1980; Brackman and Scoville 1980). This region contains luminous infrared sources and ultra compact H II regions. A young star cluster may be forming in this region. Recent interferometric high angular-resolution observation revealed a bipolar outflow toward IRS 5 in the CO emission (Claussen *et al.* 1984) and a mass condensation in the HCN emission (Wright *et al.* 1984) in this region.

We have carried out a CO (J = 1-0) and a CS(J = 1-0) mapping in the 2'× 2' area of the W3 core using the Nobeyama 45-m telescope. The angular and velocity resolutions are 15" and 0.65 km s^{-1} for the CO observations, and 33" and 0.2 km s^{-1} for the CS observations, respectively. The field of our observations is larger than those of previous interferometric observations. We can see the overall structure of a young star cluster with high angular-resolution.

Our main results are:

1. The CO spectra have a wide variety of velocity components which appear and disappear from point to point. Each of these velocity components corresponds to a localized maximum in the equalvelocity maps (Figure 1). Most of these components do not coincide with known IR sources. These components may form part of a shell around IRS 5-7. The size of the condensations is <0.1 pc. The velocity widths of the components are typically 2 km s^{-1}.

2. Some of the CO emission features at blue- and red-shifted velocities around IRS 5 correspond to a bipolar outflow which has been noticed by Claussen *et al.* (1984) (Figure 2).

3. There is a steep systematic velocity gradient from the northwest to the southeast of the central infrared cluster IRS 3-7 where the CO profiles are self-reversed. The steepest velocity gradient of 14 km s^{-1} pc^{-1} for the CO emission (Fig. 2) and 11 km s^{-1} pc^{-1} for the CS emission (Figure 3b) occurs toward the IRS 5-7 position. Although this has been interpreted as a rotation (Brackmann and Scoville 1980), this

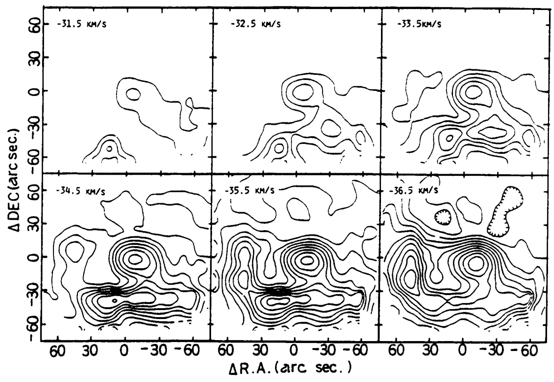

Fig 1.a

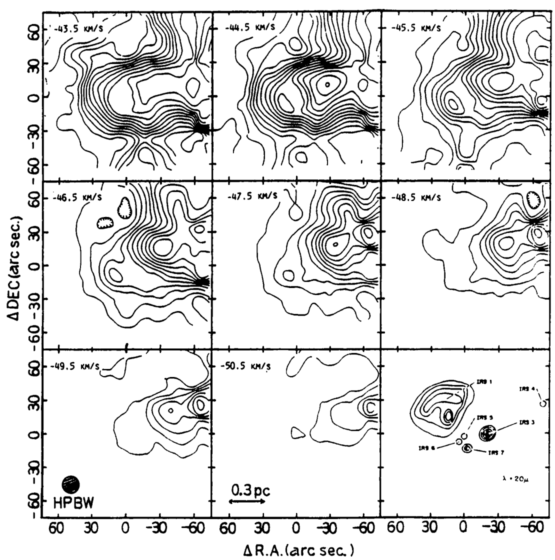

Fig 1.b

Fig. 1. Equalvelocity maps of the red- and blue-shifted CO emission; contour levels are 7.5, 10.0, 12.5, 15.0, 17.5, 20.0, 22.5, 25.0, 27.5 K km s^{-1}. The integrated velocity width is 2 km s^{-1}. Many condensations are seen. Some of them form the shell-like structure IRS 5-7. Their typical sizes are less than 0.1 pc, and their shell radius is 0.5 pc. They may be the high temperature, relatively rare condensations of gas pushed out by the high velocity outflow of nearby infrared sources or by the south ultra compact H II regions. For the blue-shifted emission, there is a steep systematic velocity gradient, which has been interpreted as a rotation from the northwest to the southeast of the central infrared cluster IRS 3-7 where the CO profiles are self-reversed. The infrared source map was obtained by Wynn-Williams, Becklin, and Neugebauer (1972).

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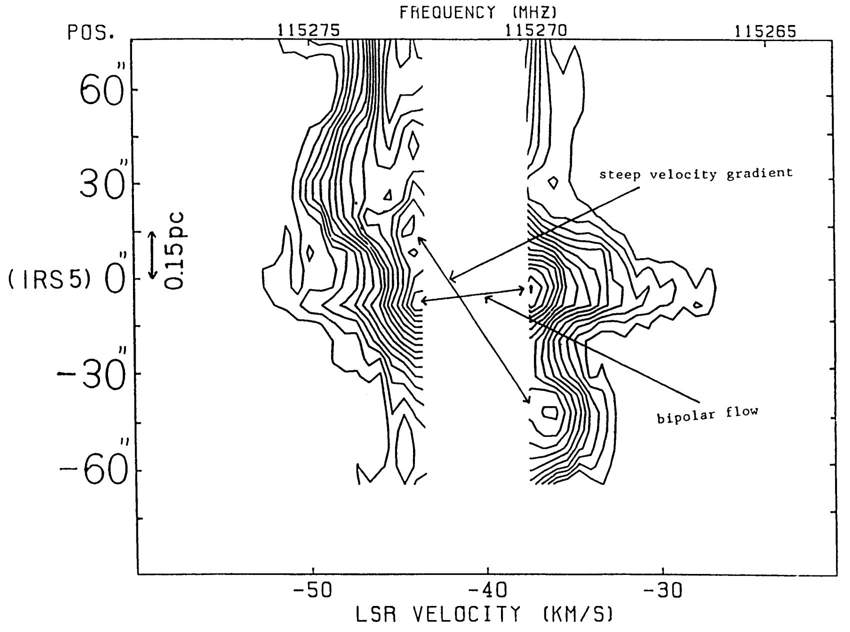

Fig. 2. The position-velocity map of the CO emission; positions are shown in Figure 1b. Contour levels are 1,2,3,4....K. This map shows a bipolar flow around IRS 5 superposed on a steep velocity gradient.

gradient is difficult to attribute to a rotating motion of the whole cloud core because the distribution of mass seems to be highly asymmetric with respect to IRS 5-7, as is suggested by the CS (J = 1-0) map (Figure 3a).

4. From the CS observations, the dense region of the molecular cloud is to the west of IRS 5-7 (Fig. 3). This result agrees with the CO(J = 2-1) observations (Thronson 1986). No steep velocity gradient is found toward this massive main body of the cloud. The peak-velocity map of the CS emission (Fig. 3b) has S-shaped curved contours around IRS 5-7.

There is no feature in the CS map corresponding to the clumpy structure seen in the CO map. The absence of the cumply structure in the CS map may suggest that either the CO clumps are hot and diffuse so that they are not observed in the CS emission or they are dense but small enough to be diluted by the CS beam. In the former case, they might have been pushed out by the nearby infrared sources (IRS 3-7), or they may be heated by the southern compact H II regions such as J and K of Colly (1980). In the later case, they can be collapsing to form stars.

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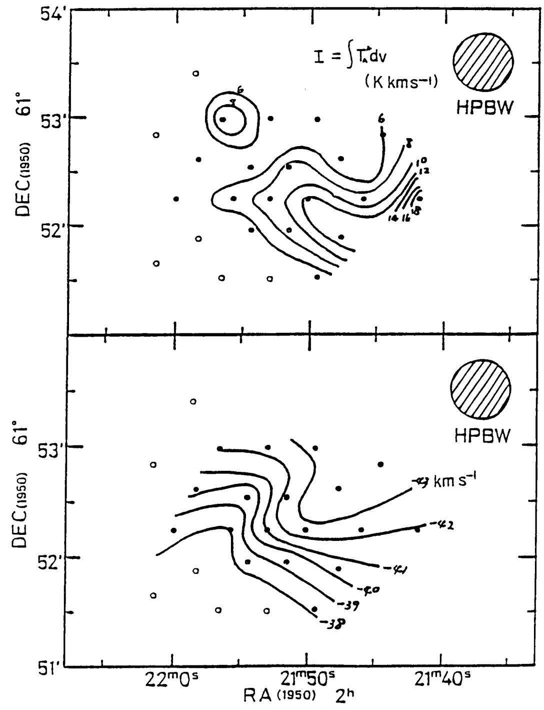

Fig. 3. (a) Integrated intensity map, and (b) peak-velocity map of the CS emission; the map center is IRS 5. The integrated intensity map shows that the dense area is at the west of IRS 5-7. Isovelocity contours have a S-shaped curvature around IRS 5-7. The distribution of mass seems to be highly asymmetric with respect to IRS 5-7.

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