FINE STRUCTURE OF MOLECULAR CLOUDS WITHIN 1 MINUTE OF ARC OF THE GALACTIC CENTER

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We have observed the HCN(J=1-0) line in the vicinity of the galactic center with the 18" beam of the Nobeyama 45-m telescope. Profiles were taken at 53 points within 1 arcmin from the galactic nucleus [R.A. = 17h42m29.29s, Dec. = -28°59'17.6" (1950)] with a 10" grid (see figure 1). A SSB cooled-mixer receiver (T_{RX} = 600 K) and a wideband AOS (acousto-optical radiospectrometer) with 250 kHz resolution were used.

Figure 1 shows the brightness distributions in selected velocity ranges where the effects of absorption are not dominant. These maps show a remarkable change of cloud velocity from lower right (negative Δl, negative Δb) to upper left (positive Δl, positive Δb), apparently

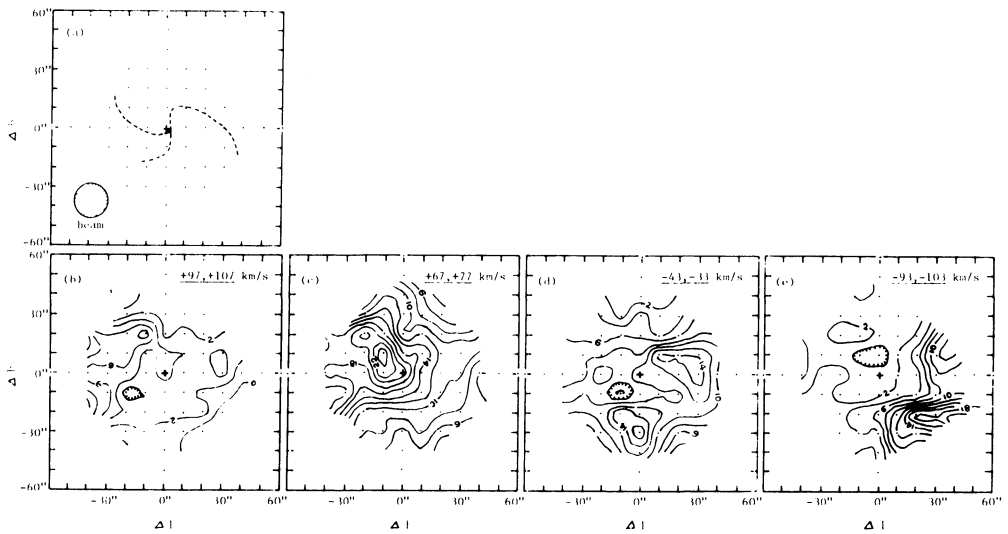

Figure 1. (a): Observed points and beam. The broken lines show the loci of ionized spirals taken from Ekers et al. (1983). (b)-(e): Brightness distributions in the HCN line, in selected velocity ranges. The cross indicates the position of the compact radio source.

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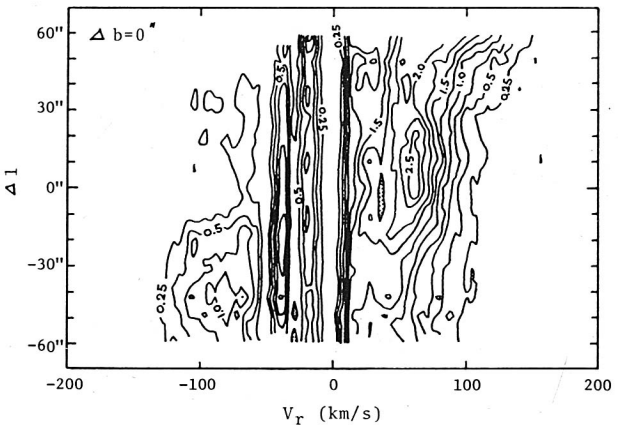

Figure 2. Longitude-velocity map of HCN.

indicating a rapid rotation of massive, cold molecular clouds around the galactic center. The axis of rotation is tilted about 40° from that of the Galaxy, and roughly coincides with that of the proposed "precessing jet" (Brown, 1982).

In figure 2 the negative-velocity feature seems to be separated into two components near the nucleus; on the other hand the positive-velocity feature reaches the position of the nucleus. This separation in the negative-velocity feature is probably caused by absorption against the central continuum sources. The existence of strong mm-wave continuum sources is indicated by deep absorption features with negative line temperatures in the profiles from these points. The longitude-velocity map (figure 2) also indicates that the negative-velocity feature is affected by absorption near the nucleus.

For this reason we put the negative-velocity cloud in front of the nucleus and the positive-velocity cloud, which does not show any sign of absorption, behind the nucleus. The expansion velocity derived from figure 2 is about 30 km s^{-1} for the negative-velocity side and somewhat lower than 60 km s^{-1} for the positive side. The rotation velocity is 80-90 km s^{-1}. Because of the limited observed area, the outer boundaries of the rotating clouds were not observed. But we can recognize corresponding features in the CO maps by Liszt et al. (1983), from which we have estimated the radius of this cloud to be 6 pc or somewhat smaller. The similar extent of far-IR radiation shown by Becklin et al. (1982) also supports the existence of massive molecular clouds surrounding the nucleus.

Comparing our results with the continuum mini-spiral (Brown et al. 1981, Ekers et al. 1983), we note that the masive cold clouds seem to have a correlation with the ionized gas. The arms of the mini-spiral seem to run along the edges of the molecular clouds. H110α measurements (Bregman and Schwarz 1982) show high positive velocities in the east arm which runs along the positive-velocity part of the molecular cloud, and also show high negative velocities in the west arm which runs along the

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negative-velocity molecular cloud. Taking into account that the mini-spiral has a thermal spectrum, we point out the possibility that the spiral arms are ionized regions distributed along the boundaries of the molecular clouds. The age of these expanding and rotating molecular clouds should be short, due to the tidal force of the central mass and due to the expanding motion. Thus we consider that these clouds may be remnants of recent activity in the nucleus.

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DISCUSSION

C.A. Norman: Where would you put the third component of the central spiral, which might be a jet, in your model?

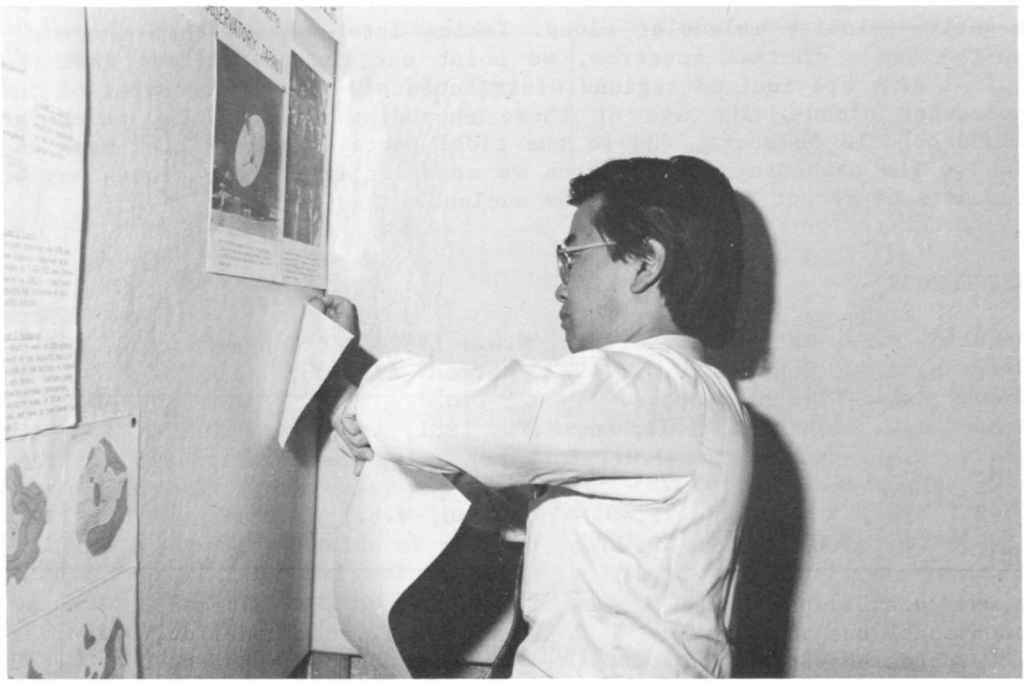
Kaifu: We do not know its shape, but the rotation is not rigid. I think it is larger on the far side, but the change is slow.

J.H. Oort: Has any of this material been published?

Kaifu: Not yet. We hope to publish it soon.

B.F. Burke: Where will it be published?

Kaifu: We do not know yet.



Top: Kaifu mounts his poster CFD
Bottom: At dinner, left to right: Katrin Särg, Mo Jing-Er, Fujimoto and Kaifu LZ

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