COLD HI GAS IN THE REGION OF THE GIANT MOLECULAR CLOUD NEAR M17

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Sato and Fukui (1978, hereafter SF) studied the HI 21-cm line in the giant molecular cloud near M17 and showed that the self-absorption of the 21-cm line is a useful tool for probing star-forming clouds. The giant molecular cloud at V(LSR) $\sim$ 20 km s^{-1} has been found to extend 4° ($\sim$170 pc) southwest of M17 (Elmegreen et al. 1979). To gain a better knowledge of its physical conditions, we used the data from the Maryland-Green Bank Survey (Westerhout 1973) to examine the self-absorption features of the 21-cm line in and around the whole molecular cloud except the two fragments adjoining M17. The HI profiles at every $0\overset{\circ}{.}1$ in galactic latitude and longitude in the region were analyzed in almost the same manner as in SF by assuming that the spin temperature of the cold HI gas is equal to 20 K. The distance was taken to be 2.5 kpc.

The main results are as follows:

1. As shown in Fig. 1, the overall distribution of column density N(HI) is somewhat similar to that of the ^{12}CO emission. However, the cold HI gas is not distributed so fragmentarily as the CO gas, and seems to form a single cloud. Moreover, at lower longitudes, the maxima of the N(HI) and of the CO emissions do not coincide with each other. The N(HI) peak at $\ell = 12\overset{\circ}{.}9$, $b = -0\overset{\circ}{.}2$ is located in a region of very weak CO emission, and the CO maximum near $\ell = 12\overset{\circ}{.}8$, $b = 0\overset{\circ}{.}6$ has no remarkable HI counterpart.

2. The velocity at maximum absorption V_c varies between 17 and 23 km s^{-1}. In the region south of the line AB in Fig. 1, V_c is mostly 20 km s^{-1} or higher, and in the northern half it is usually lower than that. Across the line AB, a gradual velocity gradient of $\sim$0.1 km s^{-1} pc^{-1} is found over $\sim$1°. It can be interpreted as a rotation of the HI cloud about the axis AB with a period of $\sim 5 \times 10^7$ years.

3. The line width at half maximum, ΔV, ranges from 4 to over 10 km s^{-1}. A few regions have double-dipped profiles with $\Delta V \gtrsim 8$ km s^{-1}. The marginal area of the cloud usually has less wide profiles than the inner region, which may represent a contraction as argued in SF.

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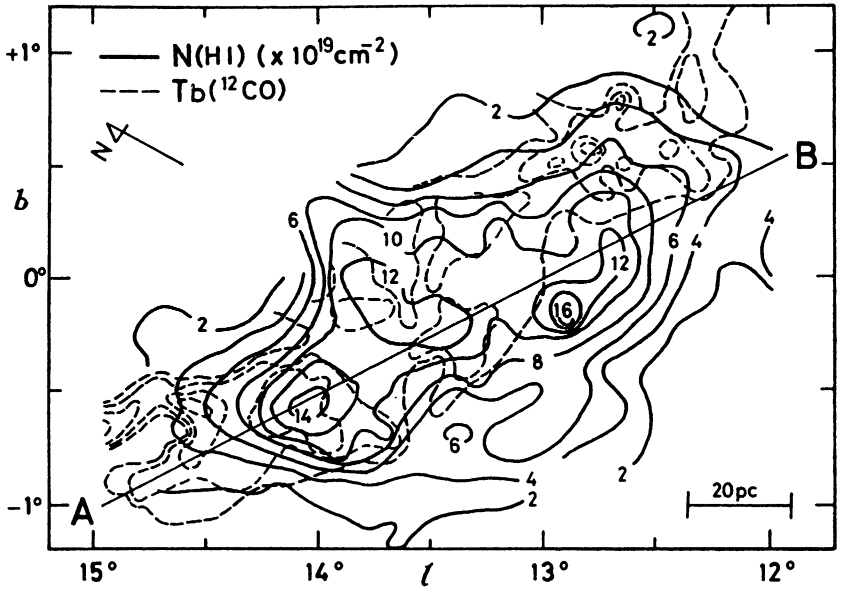

Figure 1. Distribution of the cold HI column density and that of the ^{12}CO brightness temperature (Elmegreen et al. 1979).

4. Ratios of number densities $[H_2]/[HI]$ were estimated for some CO emission peaks by using our N(HI), N(^{13}CO) (Elmegreen et al. 1979), and $[^{13}CO]/[H_2] = 2 \times 10^{-6}$ (Dickman 1978). The results are 350 for fragment C ($\ell \sim 14\overset{\circ}{.}6$, $b \sim -0\overset{\circ}{.}6$), 120 for fragment D ($\ell \sim 14\overset{\circ}{.}1$, $b \sim -0\overset{\circ}{.}6$), and 230 for the peak near $\ell = 12\overset{\circ}{.}8$, $b = 0\overset{\circ}{.}6$. In the region with extended, weak CO emission between $\ell = 13°$ and $14°$, the ratio becomes significantly lower, i.e., from 13 to 70. These low ratios are also found in the W3 and W4 molecular complex (Hasegawa et al. 1979). Such a wide range of $[H_2]/[HI]$ ratios may reflect different physical conditions and evolutionary stages in the various parts of a giant molecular cloud.

5. In the southern region where there is no detectable CO emission, the total mass can be estimated to be $\gtrsim 10^4$ $M_\odot$, if $[H_2]/[HI] \gtrsim 10$ is assumed

The HI data reduction was made on the FACOM 230-58 computer at the Computing Center, Tokyo Astronomical Observatory.

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