would raise the peak line temperature by a factor of 4, to 10 K. Thus, $\tau(^{12}C^{18}O)$ would be about 0.1 in this line and optical depth effects would not be very important.

IMAGES OF STAR FORMING REGIONS IN CO AND H_2

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A collaboration between Nobeyama Radio Observatory and UKIRT has produced high resolution images in CO and H_2 of the star forming regions DR21, Orion, and M17. In each case the images in the two species are remarkably similar. This is a striking result, for the H_2 traces a very hot component of the interstellar medium, either shocked to temperatures around 2000 K or highly excited by ultraviolet fluorescence.

The velocity resolution of the CO data is ample to demonstrate the morphology and dynamics of the violent interaction between these H II regions and their parent molecular clouds. DR21 shows a large jet-like structure, the prominent ionization fronts of the Orion Nebula drive conspicuous shocks, and M17 has the expanding shell structure expected of a blister H II region.

RELATION BETWEEN PHYSICAL ENVIRONMENT AND ITS CHEMISTRY IN ORION KL

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1. INTRODUCTION

Orion KL is a famous high-mass star forming region, and many investigations have studied its dynamical aspects. But the chemical aspects of Orion KL are still veiled. In this paper, from chemical and physical analysis, we show that there are differences in the chemistry among many "velocity elements" in the core of Orion KL.

2. OBSERVATIONS AND DATA

The observations were made using the 45-m telescope of Nobeyama Radio

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Observatory in the frequency ranges: 34.25 - 50.00, 83.50 - 84.50, 86.00 - 91.50, 96.20 - 96.70, and 108.90 - 109.40 GHz, in the direction of IRc2 (α(1950.0) = $05^h32^m46.9^s$, δ(1950.0) = -05°24'24").

We detected 215 spectral lines altogether: 170 molecular lines, 28 recombination lines from H and He, and the rest are unidentified.

3. THREE-DIMENSIONAL ANALYSIS OF ORION KL

Most spectral lines have non-gaussian line-shapes suggesting that they contain a few velocity components. We decomposed the profiles into velocity components of Gaussian form.

In the next step, we derived the rotation temperatures, T_{rot}, and column densities of molecules in each velocity component by drawing rotation diagrams.

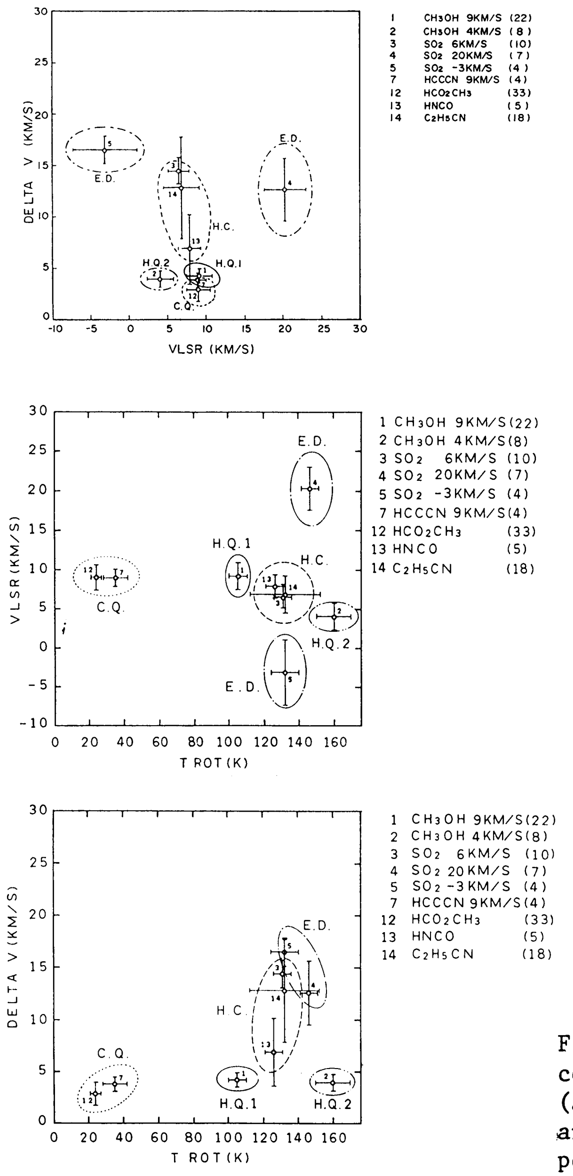
Then the velocity components were classified THREE DIMENSIONALLY in terms of V_{LSR}, ΔV and T_{rot} (Figures 1a - 1c). The physical parameters of classified "elements" are summarized in Table 1. Our results show that: (i) spectral lines from "the rotating disk" (Hasegawa *et al.* 1984) consist of photons emitted from three different regions (C.Q., H.Q.1 and H.Q.2), (ii) the -3 km s^{-1} and the 20 km s^{-1} components of SO_2 correspond to "the Expanding Doughnut" found in SO (Plambeck *et al.* 1982).

Table 1. Physical Parameters of Velocity Elements in Orion KL

Component	V_{LSR} (km s^{-1})	ΔV (km s^{-1})	T_{rot} (K)	Molecules (Number of Lines)
Hot and Quiet 1 (H.Q.1)	∿ 9	∿4	∿100	CH_3OH (22) (CO,HCN,HCO^+,CS, etc.)
Hot and Quiet 2 (H.Q.2)	∿ 4	∿4	∿160	CH_3OH (8)
Cold and Quiet (C.Q.)	∿ 9	∿(2-4)	∿(20-40)	HCO_2CH_3 (33),HCCCN (4)
Hot Core (H.C.)	∿ 6	∿(10-20)	∿130	SO_2(10), HNCO (5), C_2H_5CN (18), (SO,NH_3)
Expanding Doughnut (E.D.)	∿ (15-20) ∿ (-7 -0)	∿ 15	∿ (120-140)	SO_2(7), SO, (CS,HCN, H_2CO)
Molecular Flow (M.F.)	∿ 9	$\lesssim$ 100	?	(CO,HCO^+,SO)

IV. CHEMISTRY IN ORION KL

We calculated the fractional abundance of molecules relative to H_2 in each element (Figure 2). This figure shows a clear difference of



Figures 1a-1c. Plots of velocity components of each molecule on the (a)V_{LSR} - ΔV, (b) T_{rot} - V_{LSR}, and (c) T_{rot}- ΔV planes, respectively.

chemistry between elements on the rotating disk and the hot core + the expanding doughnut: the former contains mainly simple molecules such as HCN, HCO^+ and CH_3OH, while the latter is abundant in organic molecules such as C_2H_5CN and in molecules containing the S-O bond.

This difference of chemistry is related to the difference of the physical environment (temperature, density, gaseous turbulent motion, etc.), and the difference of the physical environment may be maily caused by the strong stellar wind from IRc2. Therefore, it seems plausible that IRc2 plays an important role in determining the chemistry in the shocked region of the core of Orion KL.

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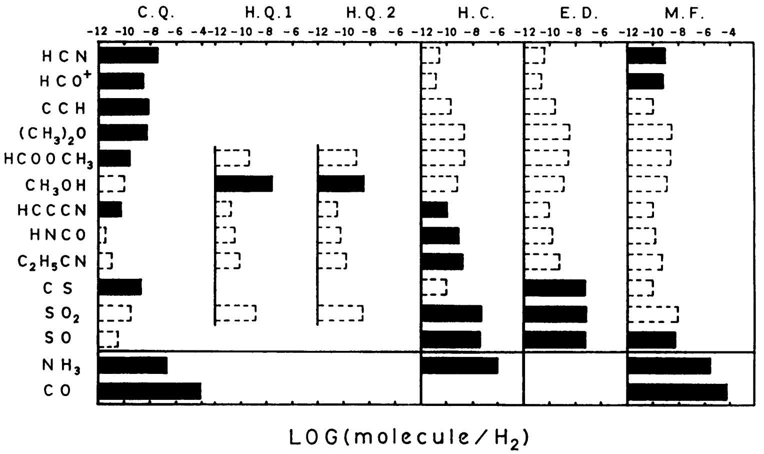

Fig. 2. A histogram showing the relative abundance (painted black) or an upper limit to the relative abundance (broken lines) of molecules to molecular hydrogen for all elements. Data with an asterisk (NH_3 and CO) were taken from Irvine *et al.* (1984).

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^{13}CO(J = 1-0) OBSERVATIONS OF THE ORION MOLECULAR CLOUD

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We present new ^{13}CO(J = 1-0) measurements of the Orion molecular cloud. The data were taken with the 4-m millimeter-wave telescope of Nagoya University with a beamwidth of 2.7'. The high velocity resolution of 0.1 km s^{-1} employed has revealed significant details of the ^{13}CO emission toward the H II region.

The results indicate that an appreciable portion of the molecular gas toward the Orion nebula is interacting with the H II region. In particular, the molecular gas within about 1 pc of the Trapezium stars appears to be interacting strongly with the H II region. There is evidence

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