FURTHER OBSERVATIONAL STUDIES OF THE HIGH VELOCITY MOLECULAR SOURCE ("PLATEAU") IN ORION

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ABSTRACT

Sensitive measurements have been made of the profiles of various molecular lines in the direction of the BN/KL infrared complex in Orion. Similar line shapes are found for the high velocity wings ("plateau") of most lines observed. The position of the high velocity source (HVS) was found in SO and HCO^+ relative to the SiO maser. A search for HV emission in other sources was unsuccessful.

OBSERVATIONS

Low noise spectra of the J=0-1 transitions of ^{12}CO, ^{13}CO, HCN, HCO^+, and N_2H^+, of the 3_2-2_1 transition of SO, the 8_{17}-8_{08} transition of SO_2, and the J=7-6 transition of OCS were obtained with the NRAO 11-m telescope for the KL/BN region in Orion. A search was made for the J=5-4 transition of SiS. The 2_2-1_1 transition of SO was mapped simultaneously with the v=1 J=2-1 transition of SiO. Mapping observations of HCO^+ and SiO were interleaved. A search was made for CO J=0-1 emission at large velocities relative to the line center in W3 (IRS5 and OH), NGC1333 (IR and H_2O), Ori MC2, Mon R2 (IRS2 and IRS3), NGC6334 (IRS1), M17 (IRS1), GL2591, DR21(OH), and NGC7538 (IRS1).

LINE SHAPES

We found that ^{12}CO, ^{13}CO, HCN, HCO^+, SO, and SO_2 have emission at $|\Delta V|$ > 20 km/s (where ΔV=0 at V_{lsr}=9 km/s), and that this emission is centered at V_{lsr}=9±1 km/s for all these lines. The emission for $|\Delta V|$ > 20 km/s has the same dependence on ΔV, namely that the intensity varies as $|\Delta V|^{-2.3}$. Emission for $|\Delta V|$ < 20 km/s shows different dependences on $|\Delta V|$ for different lines. Comparison with profiles of the ^{12}CO J=1-2 and J=2-3 lines (Phillips 1978, private communication), of the 3_{13}-2_{02} transition of H O (Waters et al. 1980), and the 1_{10}-1_{01} transition of H_2S (Kuiper, 1978, private communication), shows the same behaviour for $|\Delta V|$ > 20 km/s, although the signal-to-noise ratios are lower. No HV emission was seen in N_2H^+ (<0.1 K at $|\Delta V|$ =20 km/s). OCS showed a broad

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spectral feature centered at 6 km/s, while a narrow and more intense component was centered at 4 km/s. The SiS J=5-4 transition was not seen at all to an upper limit of 0.2 K.

The conclusion that the J=0-1 transition of ^{12}CO is optically thin in the wings (Wannier and Phillips 1977) is confirmed by the ratio of the J=1-0 ^{12}CO and ^{13}CO wings, which are in the ratio of ∿40 deduced by Wannier et al. (1976) for dense clouds. Assuming that the emission in the other lines comes from the same region and that the emissions are in thermodynamic equilibrium at 70 K (Pickett and Davis 1979), we find that HCO^+ and HCN are in the ratio found in molecular clouds (Wootten et al. 1978), that SO_2, SO, and H_2S have ratios typical of molecular clouds (Gottlieb et al. 1978), but that HCO^+ and HCN are overabundant relative to CO by a factor of at least ten (Wootten et al. 1978). Statistical equilibrium calculations carried out for the 3_{13}-2_{02} line of H_2O also indicate that H O is overabundant by a similar factor relative to CO (Waters et al. 1980).

SOURCE POSITIONS

The position of the HVS in SO is indistinguishable from the position of the SiO maser source to a 1 sigma accuracy of 2 arcseconds. The HCO^+ centroid was found to be 16 arcsec north and 6 arcsec west of the SiO maser with an estimated uncertainty of 5 arcseconds.

SEARCH FOR OTHER HIGH VELOCITY EMISSION SOURCES

To a r.m.s. noise level of typically 0.2 K, no emission was seen at $|\Delta V|$ =20 km/s in any source except M17, in which the presence of multiple components made it impossible to determine whether broad wing emission was present. Taking into account the distances of the sources, we conclude that emission of the intensity seen in Orion is not present in NGC1333 (IR or H_2O), Ori MC2, Mon R2 (IRS2 or IRS3), or NGC6334 (IRS1). For the other sources, HV emission of the intensity seen in Orion would not have been detected.

REFERENCES

Gottlieb, C.A., Gottlieb, E.W., Litvak, M.M., Ball, J.A., and Penfield,H.: 1978, Astrophys. J. 219, pp. 77-94.

Phillips, T.G., Huggins, P.J., Neugebauer, G., and Werner, M.W.: 1977, Astrophys. J. (Letters) 217, pp. L161-L164.

Pickett, H., and Davis, J.H.: 1979, Astrophys. J. 227, pp. 446-449.

Wannier, P.G., Penzias, A.A., Linke, R.A., and Wilson, R.W.: 1976, Astrophys. J. 204, pp. 26-42.

Wannier, P., and Phillips, T.G.: 1977, Astrophys. J. 215, pp. 796-799.

Waters, J.W., Gustincic, J.J., Kakar, R.K., Kuiper, T.B.H., Roscoe, H.K., Swanson, P.N., Rodriguez Kuiper, E.N., Kerr, A.R., and Thaddeus, P.: 1980, Astrophys. J. in press.

Wootten, A., Evans, N.J., II, Snell, R., and Vanden Bout, P.: 1978, Astrophys. J. (Letters) 225, pp. L143-L148.