HIGH SPATIAL RESOLUTION STUDIES OF $H^{13}CN$, $H^{12}CN$ AND HCO^+ J = 1-0 EMISSIONS IN ORION A

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The distributions of the $H^{13}CN$, $H^{12}CN$ and $H^{12}CO^+$ J =1-0 lines have been mapped with 20" spacing towards the Orion A molecular cloud using the new Onsala 20 m millimeter wave telescope equipped with a room temperature mixer. The aperture and main beam efficiencies are about 49 and 65% and the half power beam width is ~ 43". The absolute pointing accuracy is estimated to be better than 5" rms in the Orion elevation range.

The Orion A ridge and pedestal cloud emissions have been separated by gaussian decomposition. The HCN pedestal emission region has been partly resolved. Its position and shape* agree with the features of the Becklin-Neugebauer/Kleinmann-Low infrared cluster, suggesting that the broad molecular line emissions are composite results of expanding envelopes around the individual objects in the cluster. The HCO^+ pedestal emission is weak compared to that of HCN while the narrow line intensities of the two species are about the same in the N-S elongated ridge cloud. The latter cloud exhibits notable velocity shifts also on a scale as small as 20" (0.05 pc). The asymmetric map center ridge lines are decomposed into two gaussians at 7.8 and 10.0 km s^{-1}, the latter being strongest. A theoretical model analysis of the data has been performed.

A similar mapping has been done around S140 IR. The HCN/HCO^+ emission maximum is very close to the 2μ/100μ source position. No pedestal feature was detected, which may suggest that this object - in the infrared very similar to BN - has not yet reached the BN stage of evolution.

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*Position (1950.0): $5^h32^m46.9^s \pm 0.2^s$, $-5^o24'25'' \pm 4''$. The half power size of an assumed gaussian source is $\lesssim$19" N-S, $\lesssim$13" E-W. These data are almost in complete agreement with Effelsberg NH_3 data by Wilson, Downes and Bieging (1979, Astron. Astrophys. 71, 275). Our position also agrees within 1" with that of the SiO (v=1,J=1-0) maser (Moran et al. 1977, Astrophys. J. 217, 434).

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DISCUSSION FOLLOWING HJALMARSON

Zuckerman: The Kuipers and I have measured the positions of the HCO^+ and SO high velocity "plateau" sources in Orion with the NRAO 36-ft. telescope. We agree with your position for HCO^+ (i.e. north of BN), but find the SO source to be centered within a few arc seconds of the SiO maser sources. Therefore, those people who consider the chemistry of the plateau source should be aware that plateau emission from different molecules may originate in different regions.

Hjalmarson: It is very interesting and, I think, also convincing that our data agree so well. Our HCN plateau position is almost identical to your SO source. Definitely the different distributions of the plateau molecules must be important for "astrochemists". Shock enhancement could be a very important process.

Kuiper: I should like to amplify the remark by Zuckerman. While we have high confidence in the SO plateau position relative to the SiO maser, the formal errors in the HCO^+ position may well be dominated by systematic errors in interpolating the pointing offsets deduced from the SiO maps. These are hard to estimate but I would guess the uncertainty is about 5 arcseconds.

I also want to draw your attention to another part of our paper which concerns the line shapes. The shapes of the lines reported are the same for relative velocities outside ±20 km/s, but are very different for different lines inside this limit. In the most sensitive of these data, it is very clear that the plateau line-shape is not Gaussian. One should therefore bear in mind that a Gaussian decomposition may lead to deceptive results about the amount of plateau emission in any given line.

Hjalmarson: I am very happy with the close agreement between your data and Onsala data. We also have a preliminary five point SO_2 (8_{17}-8_{08}) map which seems to agree with your SO result. I am well aware of the line-shape problems you mention in the second part of your comment. In the case of HCN the three quadrupole lines of the spike make a meaningful comparison between different plateau line shapes (where there is also a blending of quadrupole lines) very difficult. In the cases of HCO^+, SO, SO_2, CO etc. we definitely will have to work on the line-shape problem when we have cooled mixer high quality profiles.

Kutner: You have mentioned a velocity structure in the ridge feature. Our formaldehyde observations, and NH_3 observations of Ho and co-workers, show this structure to be quite interesting. With your resolution, we can learn about the clumpiness in this structure. Have you made a declination-velocity diagram from your data?

Hjalmarson: The data seem to show a clear velocity structure, ranging from ∿8.4 km s^{-1} at 80"S of KL to ∿10 km s^{-1} at 80"N. In the E-W direction we find ∿8.6 km s^{-1} at 80"W and ∿10.3 km s^{-1} at 80"E. I therefore have a feeling that Orion A deserves somewhat more extended HCN/HCO^+ Onsala maps with the cooled mixer receiver that is now available.

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