N87-15057

CO MAPPING OF THE ORION MOLECULAR CLOUD: The Influence of Star Formation on Cloud Structure

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Regions of massive star formation have long been believed to have a profound influence on the structure of their surrounding molecular clouds. In this paper, we discuss the ways in which massive star formation has altered the structure and kinematics of the Orion Molecular Cloud.

The data to be discussed in this presentation consists of a large scale map of the CO J=1-0 emission from approximately 3 square degrees of OMC-1. During 1985, the Five College Radio Astronomy Observatory 14M antenna was used to map a $2^\circ \times 1^\circ$ region centered on $\alpha(1950) = 5^h33^m00^s$ $\delta(1950) = -5^\circ30'00''$. The 1985 map, which is shown in Figure 1, is sampled at 45 arcsec spacing, which corresponds to the HPBW of the FCRAO antenna. Thus, the map contains some 12,800 individual spectra.

The region mapped in 1985 covers the well known HII regions M42, M43, and NGC1977, and the CO map contains abundant evidence of the interaction between these regions and the molecular cloud. Indeed, the global structure of the cloud appears to have been strongly influenced by the continuous formation of massive stars within the cloud. Individual instances of some of these interesting features will be discussed below, and it is interesting that there appear to be two classes of features which are indicative of this interaction: CO bright rims and CO holes.

CO Bright Rims - The region surrounding M42 contains several CO bright rim features which are the result of enhanced heating of the molecular gas at the boundary of the M42 HII region. We especially note the CO bright filaments which correspond well to the filaments and bright optical bar seen in [SII] images of M42. Other prominent examples of this morphology are the bright rim associated with NGC1977 and the local heating at the cloud edge adjacent to M43. The bright filamentary structure of the southern portion of the cloud in this map might also be due to these effects.

CO Holes - The expansion of the HII regions which accompany massive star formation can have a number of important effects on the structure of molecular clouds. Perhaps the simplest result of HII region formation is the removal of molecular gas from the vicinity of the HII region through either dissociation of the molecules or mass motion associated with the expansion of the HII region or stellar winds. The CO hole surrounding the M43 HII region offers the clearest example of such processes in action at the present time, but other examples (such as one occuring to the south of M42) suggest that previous epochs of star formation may have left their mark on the Orion Molecular Cloud.

During 1986, we have undertaken further mapping of OMC-1 to the south of the region covered by the map in Figure 1. This portion of the cloud contains significant regions of star formation, but O star formation has not occured and large HII regions have not developed to alter the appearance of the cloud. A detailed map of this region is thus an opportunity to view the structure of the

molecular cloud before it has been altered by massive star formation. Preliminary analysis of 1 square degree of data obtained in this region suggests that the structure and kinematics of the southern portion of the Orion cloud are indeed dramatically different from those of the region previously mapped. Comparison of the two regions thus supports models of the development of structure in molecular clouds through interaction with the HII regions formed within them.

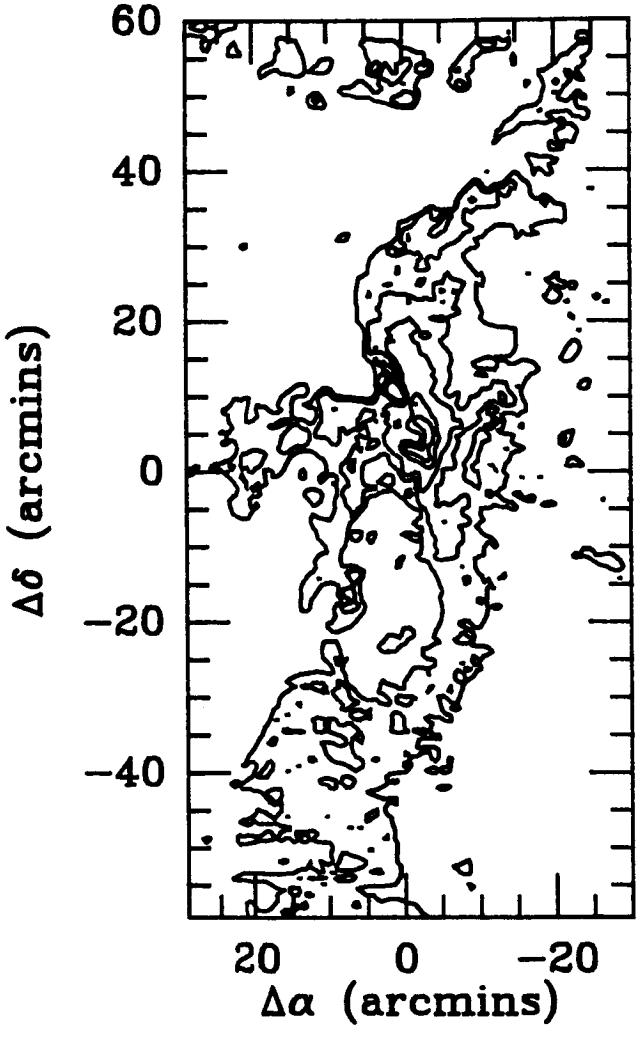

Figure 1 - Contour map of the peak antenna temperature of the CO J=1-0 emission from the Orion Molecular Cloud. Contour levels are 10K, 15K, 20K, 30K, and 40K. The map coordinates are referenced to $\alpha(1950)=5^h33^m00^s$ and $\delta(1950)=-5°30'00"$.