A SURVEY OF MOLECULAR CLOUDS ASSOCIATED WITH YOUNG OPEN STAR CLUSTERS

D. Leisawitz and F. Bash
Department of Astronomy
The University of Texas
Austin, Texas, U.S.A.

A major study of the molecular gas surrounding young star clusters is underway. We are using the Columbia University 1.2-m millimeter-wave telescope to observe emission from the J=1→0 rotation transition of ^{12}CO in the vicinities of 128 open star clusters. The survey region around each cluster is at least 10 cluster diameters in size, typically $\gtrsim$ 5 square degrees. Sensitivity is sufficient to detect lines as weak as 1 K over a range in velocity $\pm$ 83 km/s centered on the cluster velocity and with a velocity resolution of 0.65 km/s. Clusters in this sample have well-determined distances ranging from 1 to 5 kpc, and ages $\lesssim$ 100 million years (Myr).

Carbon-monoxide emission has already been mapped in regions surrounding 14 of these clusters. Preliminary results reveal a tendency for clusters younger than $\sim$ 20 Myr to show evidence of associated molecular clouds. Regions surrounding clusters older than $\sim$ 20 Myr, however, generally do not show CO emission at velocities coincident with those of the clusters. Contour maps of the velocity-integrated CO emission in five representative regions are shown in Figure 1.

The physical mechanism responsible for the removal of molecular gas from young clusters could be the propagation of a dissociation front into the molecular-cloud medium or acceleration of the clouds away from the clusters (e.g., by stellar winds or radiation pressure). A statistical analysis of a large sample of CO maps around cluster regions coupled with H I 21-cm observations, high-resolution observations of molecular line emission, and infrared maps of a small sample of representative regions is expected to reveal the nature of the mechanism. If the clouds are being destroyed, the molecular-cloud lifetime is of the order of 20 Myr.

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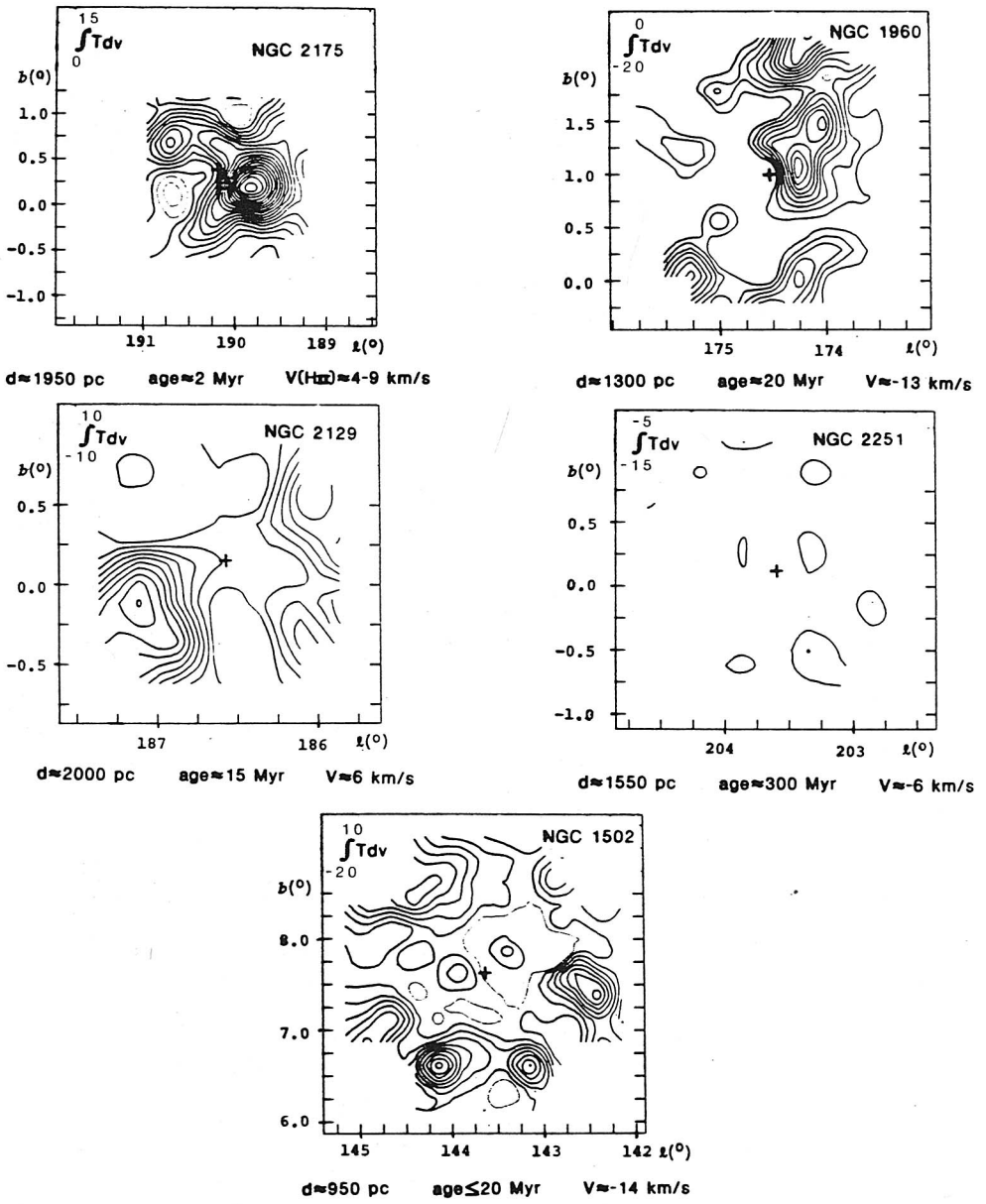

Figure 1. Velocity-integrated CO emission in regions around five open clusters. Units for integral limits are km/s. Cluster distances, ages, and velocities are indicated. Crosses mark cluster positions. All velocities are with respect to the local standard of rest. Contour levels are in steps of 1 K km/s and the lowest level is 1 K km/s, except around NGC 2175 where levels are separated by and begin at 2 K km/s.

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