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DENSE MOLECULAR GAS CLUMPS ASSOCIATED WITH CLUSTERED STAR FORMATION IN THE ROSETTE MOLECULAR CLOUD

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Millimeter-wavelength observations of molecular clumps play a crucial role in understanding the process of clustered star formation in giant molecular clouds. The morphology and chemistry of molecular material around embedded clusters defined by tracers of dense gas, allow us to describe the interaction between the newly born stars and the remnants of the condensations from which they hatched.

The Rosette Molecular Cloud (RMC) is an ideal laboratory in which to study such interactions because of its collection of embedded clusters (Phelps & Lada 1997), distributed along its almost 40 pc of longitudinal extension.

Our data were taken at the IRAM 30 m telescope facilities in 2002 July. We obtained "on-the-fly" sampled maps of seven clusters at beam size resolutions of 8 and 12 arcsec (90 and 210 GHz) simultaneously. We observed six molecular lines: HCO^+(1–0), CS(2–1), $C^{18}O$(2–1), ^{13}CO(2–1), CO(2–1) and N_2H^+(1–0). Our targets were defined from the locations of the embedded clusters in combined *JHK* images taken in 2001 December and 2002 January at the KPNO 2 m telescope using FLAMINGOS, a wide near-IR imager and multiobject spectrometer (Román-Zúñiga, Lada, & Elston 2003).

We detected CO isotope emission towards all of the seven clusters and strong, dense gas emission towards six of them. In some cases the emission was compact and well localized towards the cluster, while in others it pointed outside the main nebulosity, with significant offsets between the peaks of emission of different tracers (Figure 1), which is suggestive of photo-induced or time-dependent chemistry in the clumps. Moreover, in 5 of the 7 clusters, these offset peaks of emission contained faint, heavily reddened sources, which might belong to a slightly younger generation of stars. Detailed photometric analysis and more mid-IR and sub-mm observations are being carried out to investigate the nature of these offset cores and their possible protostellar content.

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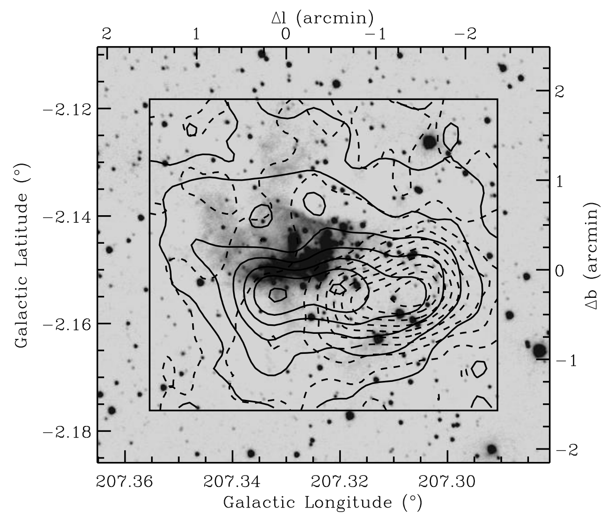

Fig. 1. Integrated HCO^+(1–0) (solid contours) and CS(2–1) (dashed contours) emission towards Rosette Cluster No. 3. Notice the offset between the emission peaks. The contours run from 0.25 K km s^{-1} in 0.75 K km s^{-1} steps. The background image is a *JHK* composite from FLAMINGOS.

Our observations also confirmed the existence of an extended outflow in cluster No. 6, which hosts the pre-main sequence binary AFGL 961 (Blitz & Thaddeus 1980; Lada & Gautier 1982). It was also confirmed that the emission profile from this source is strongly self-absorbed, and that this effect can also be seen in at least one other cluster (No. 7). This suggests that there might be strong excitation gradients in the intercluster gas—i.e., a cold envelopes surrounding hot cores, which will be useful to diagnose infall and outflows of gas from the clusters (Román-Zúñiga, Williams, & Lada 2003).

Measured properties of the dense gas clumps, such as temperature and virial mass, do not seem to vary with distance from the Rosette Nebula, which suggests that, once cluster formation has begun, it is independent of its external environment.

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