Fragmentation in Molecular Clouds

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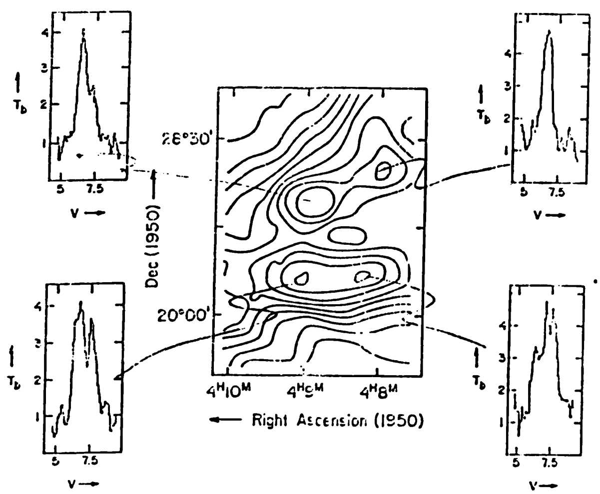
B209. Fragments are detected in the outer parts of the B209 molecular cloud in a region of density 1000 cm^{-3} using ^{12}CO, ^{13}CO, H_2CO, IRAS 60 and 100 μm images, discernable as velocity components, and have characteristics: $\langle R_{fragment} \rangle \sim$ 0.4 pc; $\langle M_{fragment} \rangle \sim$ 2 $M_\odot$; $\langle MVR_{fragment} \rangle \sim$ 1.6 $M_\odot$ km/s pc; $T_{gas} \sim$ 11 K; $T_{dust} \sim$ 16 K??. The system of fragments has $\langle separation \rangle \sim$ 0.5 pc and $\langle MVR \rangle \sim$ 1.6 $M_\odot$ km/s pc. These are illustrated in Figure 1, which contains an IRAS 100 μm map made with Geisha and attendant U. Köln Gornergrat CO spectra for each respective fragment. The differing characteristic velocities of each fragment are readily apparent.



These lower density fragments in the outer part of the cloud are not redistributing their MVR. Although no apparent star formation has occurred within these fragments, there is prodigious star formation within the central environs of B209 itself, where the gas density is only marginally higher, ~3 x 10^3 cm^{-3}. Here one finds: $\langle R \rangle \sim$ 0.3 pc; $\langle M \rangle \sim$ 15 $M_\odot$; $\langle MVR \rangle <$ .4 $M_\odot$ km/s pc; $T_{gas} \sim$ 11 K; $T_{dust} \sim$14 K. The central star forming region has redistributed a significant amount of angular momentum.

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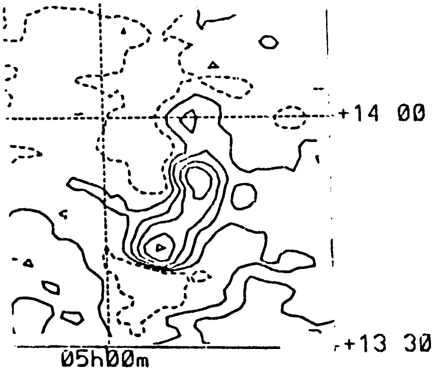
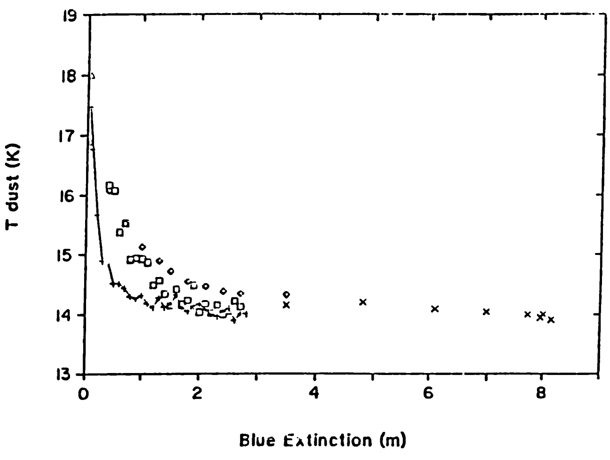
L1563 is a cloud of lower opacity than B209, with no evidence of star formation, detected using ^{12}CO, ^{13}CO, H_2CO, and all four IRAS bands. The cloud center has two clear fragments resolved in molecular and 100 μm data, and discernable in velocity. These have characteristics: within each fragment: <$R_{fragment}$>~ 0.2 pc; <$M_{fragment}$>~ 10 $M_\odot$; <$MVR_{fragment}$>~ <0.2 $M_\odot$ km/s pc; T_{gas} = 11.6 K; T_{dust} = 14.2 K; and for the cloud as a whole: <fragment separation>: 0.5 pc; <system MVR>: 5 $M_\odot$ km/s pc; <T_{gas}> = >11.6?; <T_{dust}> = 16 K. There has been a large reduction in MVR. Figure 2 shows the two detected fragments in the central core of L1563, in the form of a map of I(100) - I(60)/0.22, which effectively removes the cloud envelope and all cirrus, leaving only the dense region.



Conclusions. In these clouds, fragmentation is revealed in both infrared emission and molecular spectral lines. Redistribution of angular momentum has occurred in those fragments closest to cloud "cores", with or without accompanying star formation. The dust has a higher temperature than the gas in the regime probed. A combined dust temperature is shown in Figure 3. These data reveal T_d falling quickly in the outer cloud envelope, as predicted by Falgarone and Puget (1985), and remaining near 14 K up to extinctions of ~8^m.



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