

Probing Inward Motions in Starless Cores Using HCN(1-0) Hyper-Fine Transitions: A Systematic Survey Toward Central Regions

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HCN (1-0) contains 3 hyper-fine transitions with different optical depths and they can be used to probe different regions of the cores. The inward motions can be implied by the presence of the spectral "infall asymmetry" in each of those transitions. The velocity structures of the inward motions can be investigated by using all three hyper-fine transitions. In order to study the infall motions in starless cores, we have made a systematic survey toward the central regions of 86 sources with HCN (1-0) lines using TRAO 14-m radio telescope. Among 86 sources, 52 were detected. Thirty sources show typical infall asymmetry in at least one of the three hyperfine components. Degree of infall asymmetry and infall incidence in HCN are found to be usually more pronounced than those in CS(2-1) by Lee et al.. In order to derive infall speeds, we fit the spectra of 30 sources showing clear double peaks to a simple two-layers model. We found only two sources, L694-2 and L1197 to show higher infall speeds in a component with lower optical depth. This may be a hint of infall structure that the infall speed increases toward the center. However, most other sources do not show any systematic differences in infall speeds among different transitions. This may be either due to rather complex motions in the starless cores or imply that the different lines probe the regions which do not have significantly different infall speeds.

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