The Chemical Evolution of Cores within Infrared Dark Clouds

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Infrared dark clouds (IRDCs) were first identified as extinction features in infrared (IR) surveys of the Galactic plane, such as *ISO* and *MSX*. Early IRDC studies showed that they have high densities ($> 10^5$ cm^{-3}), high column densities ($\sim 10^{23}$ - 10^{25} cm^{-2}), and low temperatures ($<$ 25 K; Egan et al. 1998; Carey et al. 1998, 2000). IRDCs have characteristics sizes and masses of $\sim$ 5 pc $\sim$ few 10^3 $M_\odot$, respectively (Simon et al. 2006). These sizes and masses are too large for the formation of individual stars, but are typical of warm cluster-forming molecular clumps, such as Orion. The cold, compact cores within IRDCs have characteristic sizes of $\sim$ 0.5 pc and masses of $\sim$ 120 $M_\odot$, comparable to compact cores associated with high-mass star formation (Rathborne et al. 2006).

Cores within IRDCs can be separated into different classes based on their IR emission characteristics. 'Quiescent' cores display no significant *Spitzer*/IRAC or 24 μm emission, and may be pre-protostellar, starless cores. 'Active' cores contain extended, enhanced 4.5 μm emission (called 'green fuzzies' for how they appear in *Spitzer*/GLIMPSE 3-color images) coincident with 24 μm point sources, and are likely protostellar cores. 'Red' cores display bright 8 μm emission, and likely contain young stars. These classes of cores comprise a star-forming sequence of core evolution within IRDCs.

To probe the physical conditions in cores within IRDCs, we used the ATNF Mopra telescope to obtain: (1) broadband ($\sim$ 8 GHz) spectra toward cores within IRDCs, and (2) maps of molecular line emission (including HCO^+ (1–0), $H^{13}CO^+$ (1–0), HCN (1–0), $H^{13}CN$ (1–0), SiO (2–1) v=0, HNC (1–0), and N_2H^+ (1–0)) toward IRDCs. We find that the broadband spectra of the quiescent cores are consistent with cold, dense gas, while the spectra toward the active and red cores are consistent with 'hot core' chemistry. The maps of molecular line emission also show significant differences between cores in different evolutionary states. Together, these observations help constrain the chemical evolution of cores within IRDCs, the precursors to high-mass stars.