Molecules in Astrophysics: Probes and Processes

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Abstract

Title: CHEMICAL PROBES OF PROTOSTELLAR EVOLUTION: OBSERVATIONS AND MODELING

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L1498 is a classic example of a dense cold pre-protostellar core that may be on the verge of rapid collapse to form a protostar. To study the structure, dynamics, and chemical properties of this core we have obtained high spatial and high spectral resolution observations of low and high density gas tracers. These include interferometric and single dish observations of the high density gas tracers CCS at 22 and 94 GHz, interferometric maps of CS (2-1), and large scale single dish $C^{18}O$(1-0) maps. The high spectral resolution CO and CCS maps show an elongated structure with its axis at ≈ 300° running SE to NW. The high angular resolution (9") 22 GHz spectral line maps obtained by combining NASA Goldstone 70 m and VLA data show arc-like enhancements of the CCS column density in the southeast and northwest boundaries with a local minimum at the nominal core center (the NH_3 peak). This distribution suggests that CCS emission originates in a shell outside the ammonia emitting region. The OVRO-MMA spectral line maps of CCS at 94 GHz and CS at 98 GHz in selected fields were made at 6" to 9" angular resolution and 0.05 km s^{-1} velocity resolution. Both CS and CCS are diminished near the center of the disk-like core. The differences between the CCS, CS, and NH_3 emission suggest a time dependent evolution as the core evolves slowly. There are also differences in the distribution of small scale CS and CCS emission. The chemical abundances in the core are compared to time dependent models of protostellar cores. We propose that these molecules are important tracers of protostellar evolution.