Hot Disk Chemistry in Massive Star Forming Regions

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During the embedded phase of massive star formation, the surrounding materials of protostars experience vigorous physics and chemistry, resulting in intense physical conditions, such as high temperature and density. As a consequence, various high excitation molecular lines have been detected and used to probe the physical properties of these massive protostellar systems (e.g., Orion Source I [1][2]). Recent ALMA observations have unveiled the unusual structure of the inner region of IRAS 16547–4247 (an O-type binary protostellar object) with rovibrationally excited "hot-disk" tracing molecules, e.g., NaCl, SiS, and H_2O [3]. We present non-local thermal equilibrium (NLTE) analysis of the detected species to constrain the physical properties of this circumbinary system. The effects of physical conditions (e.g., temperature, density, and radiation) on the excitation of these detected molecules are explored with NLTE modeling. Furthermore, we discuss the unique chemistry for refractory species and sulfur in the massive star forming regions. Such study is essential to the evaluation of the potential of these rovibrationally excited molecules as "disk-tracers", as well as to the investigation of detailed physical and chemical structures of massive protostars.

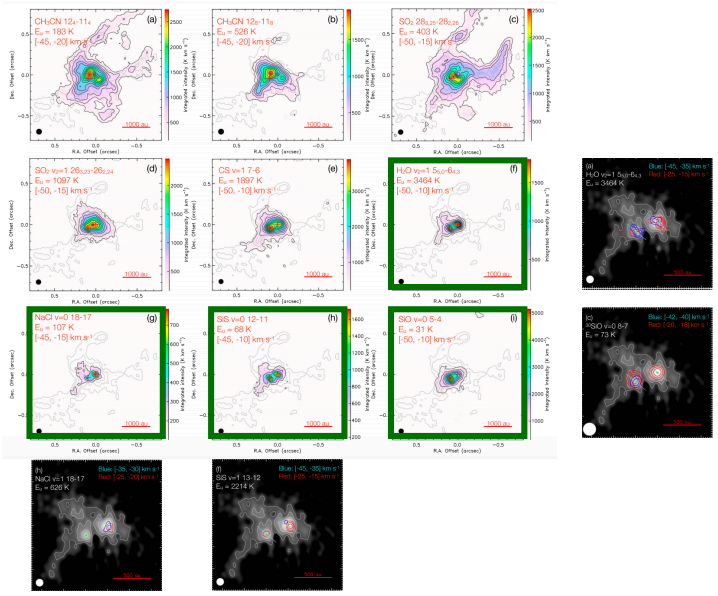

Figure 1: Integrated intensity maps of emission lines overlaid with the 1.3 mm continuum emission. The velocity maps for representative molecules are attached in grayscale.

References

[1] Tachibana, S. et al. 2019, ApJL, 875, 2, L29.
[2] Wright, M. et al. 2020, ApJ, 880, 2, 155.
[3] Tanaka, K. et al. 2020, ApJL, 900, 2, L2.