Initial star-forming activities towards the high-mass, low luminosity-to-mass ratio clumps

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Knowledge of the initial conditions is key to understanding how high-mass stars form. We are currently running a series of molecular line images towards a sample of 20 high-mass, dense, cold, low luminosity-mass ratio (<1Lsun/Msun) clumps throughout the inner Galactic plane. Each clump contains a pair of neighboring 70 micron dark and bright sources. Using the IRAM-30m telescope at at 1mm/3mm, Nobeyama-45m at 2mm, VLA at 1.4cm and SMA at 1.3mm, we characterize the physical and chemical properties of this intial star-forming sample, from a spatial resolutio of 0.1 pc to the extension of 10 pc. (1) Kinematically, we studied the fragmentation of each clump, use SiO (2-1) to trace possible shocks associated with outflow/cloud-collision towards these sources at extremely young stage, and use H13CO+/HCO+(1-0) to trace sub-pc scale infall. (2) Chemically, carrying a comparative observations of the 70 micron dark and bright source pairs, we studied the spatial correlation and relative abundances of a series of deuterated-hydrogenated pairs formed via different gas-grain paths. With the constrained source physical structure (temperature and density profile) derived from NH3 (2,2)/(1,1), we improved our deuterium chemical model, and determine the power of deuteration as evolutionary diagnosis of young stellar objects. This sample will be studied at higher-spatial resolution with ALMA, to understand the initial low-/intermediate-/high-mass SF on a global scale.

Molecular Clouds