What can chemistry tell us about the initial conditions of star formation?

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In the earliest stage of star formation, various kinematic processes compress and heat the surrounding gas intensively, driving complex chemistry, including endothermic chemical reactions, ice mantle sublimation, and sputtering. Gaseous molecular lines are now showing their power in tracing back the chemical history of several star-forming regions, which helps to disentangle the dynamic processes.

In this talk, I will introduce a multi-wavelength line survey project I am currently leading. Using IRAM-30m, NOEMA, and ALMA, we imaged a sample of 70 micron dark, dense, cold regions with L/M<1Lsun/Msun at 1mm and 3mm. From dense gas/warm gas/shock tracers covered by our broad bandwidth (32GHz) line imaging survey, we characterized the kinematic and chemical properties of these initial star-forming regions, e.g., sulfur grain reservoir, deuteration differentiations of dense gas tracers [1], pc-scale CO depletion [2], correlation between the pc-scale infall and sub-pc scale accretion, etc.

References

[1] Feng S., et. al, ApJ, 883, 202 (2019)
[2] Feng S., et. al, submitted