Chemistry of Embedded Disks in Perseus: Prevalent Complex Organic Molecules and Shock-excited Sulfur-bearing Molecules

Y.-L. Yang[1], Z. Zhang[2], and N. Sakai[2]

[1]*Department of Astronomy, University of Virginia, USA*
[2]*Star and Planet Formation Laboratory, Center for Pioneering Research, RIKEN, Japan*

In recent years, observations discover several embedded protostars that have developed complex organic chemistry in the disk-forming region. Recent observations also show potential signs of planet formation in these young disks, hinting at a stronger chemical link between the protostellar cores and planetary systems. While observations start to find rich spectra of COMs in embedded protostars, only a few observations attempt to statistically constrain the abundances of COMs at embedded protostars and their relationships to star formation processes. With the PEACHES survey, an unbiased chemistry survey of embedded protostars in the Perseus molecular cloud, we have begun to systematically characterize the COMs in the disk-forming regions[1] in addition to simple molecules, such as SO and SO_2[2]. The majority of young protostars in Perseus have COMs. For the COM-rich protostars, their column densities of COMs correlate between species, hinting at similar chemistry for the protostars in Perseus. Particularly, the abundance of CH_3OH tightly correlates with that of CH_3CN (Figure 1 left); however, a direct chemical link between these two molecules has not been firmly established. Protostellar properties, such as bolometric luminosity and bolometric temperature, have little impact on the occurrence of COMs. While emission of COMs concentrates on the embedded disk or the inner envelope, the emission of SO and SO_2 appears asymmetric in a few sources. I will discuss the origin of these asymmetry which serendipitously corresponds to major changes of polarization near the edge of disks (Figure 1 right). I will also discuss our plan to understand the origin of COMs using JWST, which is accepted to the Cycle 1 GO program.

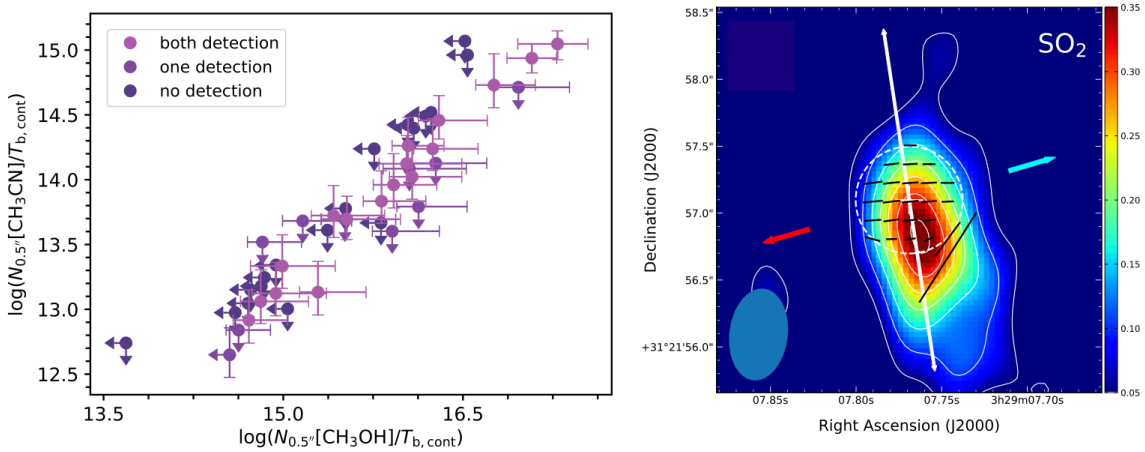

Figure 1: Left: The normalized column density correlation between CH_3OH and CH_3CN in the PEACHES sample. Right: The SO_2 emission of Per-ebb 50 compared to the linear polarization fraction. The white line indicates the disk direction, while the red and blue arrows show the outflow direction.

References

[1] Y.-L. Yang, N. Sakai, Y. Zhang, et al., 2021, ApJ, 910, 20.
[2] Z. Zhang, Y.-L. Yang, Y. Zhang, et al. 2021, in prep.