Chemical Differentiation and its Relation with the Physical Structures in Disk-Forming Regions of Young Low-Mass Protostellar Sources

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To understand the chemical origin of the Solar system, the chemical evolution along the star/planet formation is a key issue. Extensive observational studies have so for demonstrated a chemical diversity in young low-mass protostellar sources [e.g. 1, 2, 3]. Furthermore, chemical differentiations in the vicinity of the protostars have recently been reported (Figure 1). This suggests that molecular distribution is sensitive to a change in the physical conditions associated with disk formation. Some kinds of molecular lines are therefore prospected to work as molecular markers to highlight particular structures of disk forming regions. Sulfur-bearing species, for instance OCS and H_2CS, especially seem good tracers.

Conversely, detailed physical characterization is essential for elucidating the chemical evolution occurring there. It has recently been recognized that some molecular lines tend to trace the mid-plane of a disk/envelope system and others its surface [e.g. 4]. The traced kinematic structure may differ among these molecular emissions, and thus, their careful analyses are essential for further observational studies in disk forming regions. Machine learnings may help us to disentangle the observed structures.

In this presentation, we would like to report recent progresses in delineating the chemical differentiation and the physical structures in disk forming regions of young protostellar sources (IRAS 16293-2422 A, L483, B335, etc.) with ALMA.

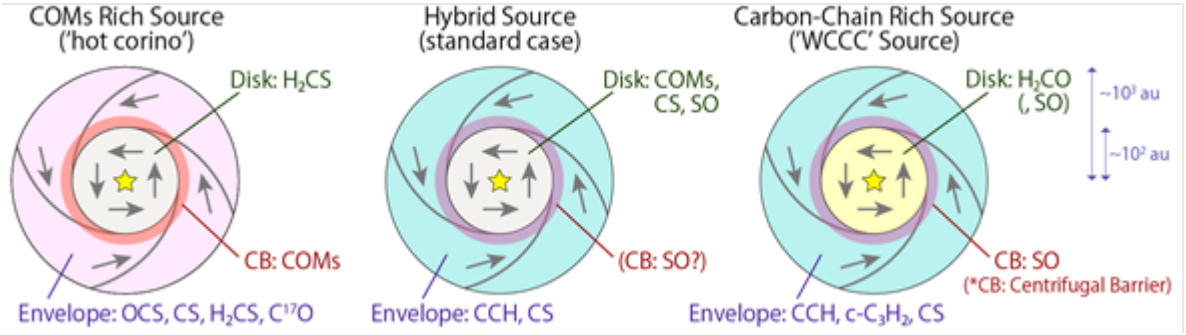

Figure 1: Chemical differentiation in disk forming regions of young low-mass protostellar sources with different chemical characteristics.

References

[1] Cazaux et al., 2003, ApJL, 593, 51.
[2] Bottinelli et al., 2004, ApJL, 617, 69.
[3] Sakai and Yamamoto, 2013, ChRv, 113, 8981.
[4] Podio et al., 2020, A&A, 642, L7.