ALMA Observations of the Young Bursting Star V883 Ori: Chemistry of Complex Organic Molecules in the Protoplanetary Disk

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Complex organic molecules (COMs), potential precursors of prebiotic molecules, are key to understanding the chemical evolution from the interstellar medium to planetary systems. Recent interferometric observations suggest that COMs are abundant in the warm inner envelopes around low-mass protostars. However, complex organic chemistry in protoplanetary disks, the immediate birthplace of planets, is still poorly understood because COMs are frozen out and thus hidden from view in archetypal disks [1].

Recent ALMA detections of thermally sublimated COMs in the warm disk around the young bursting star V883 Ori have opened a new window to probe the complex organic chemistry in protoplanetary disks [2][3]. We will present our new observations of COMs toward V883 Ori in ALMA Band 3 at an angular resolution of ~0.3" (or ~120 au). We detected ten oxygen-bearing COMs including ^{13}C isotopologues in the disk. We measured the abundance ratios of COMs with respect to CH_3OH and the isotopic ratios ($^{12}C/^{13}C$ and D/H) of COMs for the first time in a protoplanetary disk. The abundances of COMs are systematically higher than those in the warm envelopes of IRAS 16293-2422. The $^{12}C/^{13}C$ ratios of different COMs are consistently lower (~20-30) than the canonical ISM ratio (~69). The upper limits of COM D/H ratios (< 0.01) are also lower than those in IRAS 16293-2422. These high abundances of COMs and peculiar isotopic ratios could be explained by the efficient (re-)formation of COMs on the lukewarm dust grain surfaces from the ^{13}C-enriched CO due to the exchange reaction with $^{13}C^+$.

References

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