ALMA Discovery of Chemical Complexity at the Edge of our Galaxy

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Interstellar chemistry in low metallicity environments is crucial to understand chemical processes in the past metal-poor universe. Here we report the first detection of a hot molecular core in the extreme outer Galaxy, which is an excellent laboratory to study star formation and interstellar medium in a Galactic low-metallicity environment [1]. The target star-forming region, WB89-789, is located at the galactocentric distance of 19 kpc. Our ALMA observations have detected a variety of carbon-, oxygen-, nitrogen-, sulfur-, and silicon-bearing species, including complex organic molecules (COMs) containing up to nine atoms, towards a warm (>100 K) and compact (<0.03 pc) region associated with a protostar (~8x10^3 Lsun) (Fig.1). Deuterated species such as HDO, HDCO, D2CO, and CH2DOH are also detected. A comparison of fractional abundances of COMs relative to CH3OH between the outer Galactic hot core and an inner Galactic counterpart shows a remarkable similarity. The presence of a great molecular complexity in a primordial environment of the extreme outer Galaxy suggests that the interstellar condition to form the chemical complexity might exist from the early history of the Universe.

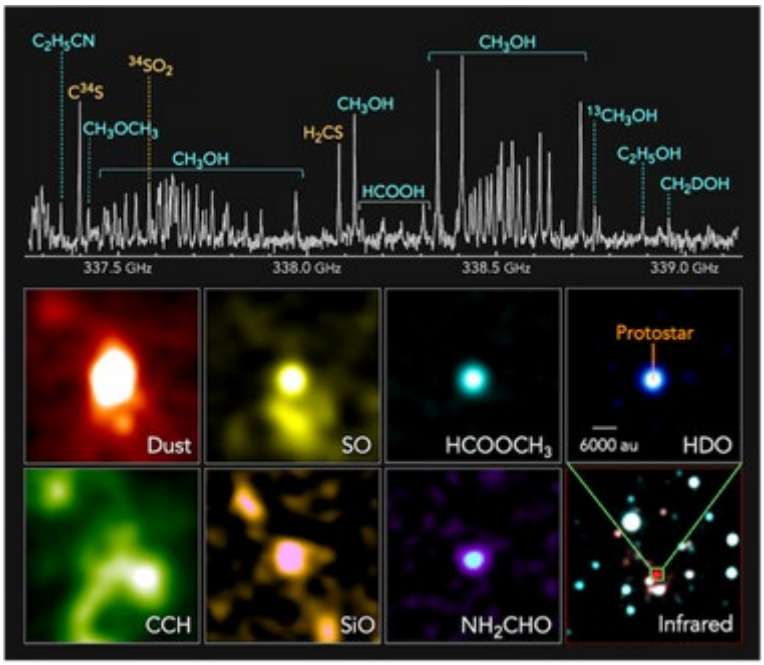

Figure 1: Examples of ALMA submillimeter spectrum (up) and molecular line distributions (bottom) for a newly-discovered hot molecular core in the extreme outer Galaxy [1].

References

[1] T. Shimonishi, N. Izumi, K. Furuya, & C. Yasui, 2021, ApJ, in press, arXiv/astro-ph: 2109.11123.