

Molecular-Cloud-Scale Chemical Composition: Mapping Spectral Line Survey toward W3(OH)

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In order to study a molecular-cloud-scale chemical composition, we have conducted a mapping spectral line survey toward the Galactic molecular cloud W3(OH) with the NRO 45 m telescope. W3(OH) is one of the most active star forming regions in our Galaxy, lying on the Perseus arm. We have observed the area of $16' \times 16'$, which corresponds to $9.0 \text{ pc} \times 9.0 \text{ pc}$. The observed frequency ranges are 87 – 91, 96 – 103, and 108 – 112 GHz. As a result, 8 molecular species CCH, HCN, HCO⁺, HNC, CS, SO, C¹⁸O, and ¹³CO are identified in the spectrum averaged over all the observed area. The spectral pattern is found to be different from that of the hot core observed at a 0.17 pc resolution. We find the following characteristics in the specially averaged spectrum: (1) Emission of the species concentrated just around the star-forming core, such as CH₃OH, HC₃N, and CH₃CCH, is fainter than the hot core spectrum and (2) whereas emission of the species widely extended over the cloud, such as CCH, is relatively stronger. The averaged spectrum is rather similar to the spectra observed in external galaxies such as M51 [1] and the Large Magellanic Cloud [2]. We have divided the observed area into 5 sub-regions according to the integrated intensity of ¹³CO, and have evaluated the contribution to the averaged spectrum from each sub-region. The sub-region with the ¹³CO integrated intensity from 10 K km s⁻¹ to 30 K km s⁻¹, which does not involve the hot core, shows the most similar characteristics to the averaged spectrum. Hence, the molecular-cloud-scale averaged spectrum seems to represent the gas extended around the star-forming core, rather than the core itself.

References

- [1] Y. Watanabe, N. Sakai, K. Sorai, et al. 2014, ApJ, 788, 4.
- [2] Y. Nishimura, T. Shimonishi, Y. Watanabe, et al. 2016, ApJ, 818, 161.