Molecular-cloud-scale Multi-line Imaging toward W3(OH) in the 3 mm and 0.8 mm bands

Yuri Nishimura[1,2], Yoshimasa Watanabe[3], Nanase Harada[4], Yuki Yoshimura[1], Kotaro Kohno[1], and Satoshi Yamamoto[5]

[1] The University of Tokyo – Japan

[2]NAOJ – Japan

[3]Nihon University – Japan

[4]ASIAA – Taiwan

Recently, molecular line observations are vigorously conducted toward extragalactic sources. Thanks to the technical advancement of observing facilities, various molecular species have been detected in such observations. Yet, available spatial resolutions are often more than a 10 pc scale toward external galaxies even with interferometers. For interpretation of spectra averaged over a 10 pc scale, it is crucial to understand the distributions of various molecular species (chemical abundance variations) and the region traced by each transition line (excitation effect). We have conducted spatially-resolved multi-line imaging toward a 9.0 pc square region centered at the Galactic star-forming region W3(OH) in the 3 mm and 0.8 mm bands with the NRO 45 m and JCMT 15 m telescopes. As a result, we identified a number of transition lines of various molecular species such as CCH, HCN, HCO+, HNC, CH3OH, CS, SO, and CO. It is revealed that the most common molecular species CCH, HCN, HCO+, and CS widely extend from the central core to the cloud peripheries. For the low-J transition lines in the 3 mm band, it is indicated that the gas in diffuse or translucent regime actually contributes to a larger fraction of the total line emission from the 9.0 pc square region [1]. On the other hand, we confirmed that the high-J transition lines in the 0.8 mm band trace almost exclusively high density, except for the 12CO (3-2) line (Nishimura et al. in prep.). In multi-transitional analysis of dense gas tracers, the difference of the emitting regions between low-J and high-J transitions should be taken into account. These results also support that the molecular composition observed in the 3 mm-band observations mostly reflects that of the widespread gas rather than that affected by local star formation activities (e.g., [2]). On the basis of these results, we will also interpret multi-line images of galaxies near and far obtained by recent ALMA observations.

References

[1] Nishimura Y. et al., ApJ, 848, 17 (2017)
[2] Nishimura Y. et al., ApJ, 818, 161 (2016)