Q12a Molecular-cloud-scale multi-line imaging toward W3(OH) in the 0.8 mm band

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Understanding structures and chemical compositions of molecular clouds is of fundamental importance for extragalactic astrochemistry. To connect global molecular-cloud properties with spatially-resolved distributions of various molecular species, we have conducted the multi-line molecular-cloud-scale imaging toward the Galactic star-forming region W3(OH) in the 3 mm band, as reported previously (Nishimura et al. 2017 ApJ, 848, 17). It is revealed that the relation between the line critical density and the molecular distribution is not straightforward, i.e., not only excitation conditions but also chemistry must be considered to explain molecular distribution. It is also indicated that the gas in diffuse or translucent regime contributes to a larger fraction of the total line emission from the 9.0 pc square centered at W3(OH).

To test the high-J transition lines of fundamental molecular species as tracers of star formation activities, we have recently carried out another multi-line imaging in the 0.8 mm band toward the corresponding area of W3(OH) with James Clerk Maxwell Telescope. In the central hot core, the lines of CS $(7-6)$, SO (8_7-7_7), ^{12}CO $(3-2)$, CCH $(N=4-3)$, CH_3OH $(1_{1,1}-0_{0,0})$, HCN $(4-3)$, HCO^+ $(4-3)$, HNC $(4-3)$, H_2CO $(5_{0,5}-4_{0,4})$, and some others were detected. In general, the high-J transition line of each species traces a more compact area around the central hot core than the lower-J transition in the 3 mm band. Molecular emissions in the 0.8 mm band seem to trace almost exclusively high density, except for the ^{12}CO $(3-2)$ emission.