Multi-Molecular Line Observation toward NGC 3627 with ALMA

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Understanding of cloud-scale chemical compositions is important for studies on galactic-scale physical conditions and gas dynamics in external galaxies. It will also constitute a fundamental base for astrochemical studies of AGNs and starbursts. With this motivation, we have conducted a spectral line survey toward the spiral arm regions of nearby galaxies and mapping spectral line surveys toward the Galactic molecular clouds. With these observations, we have revealed chemical compositions of molecular gas at a scale from 1 kpc to 10 pc (Watanabe et al. 2014, 2016, 2017, Nishimura et al. 2017). In this study, we focus on effects of galaxy-scale gas dynamics on the chemical compositions of molecular gas in the barred spiral galaxy, because shocks are predicted in the bar by theoretical studies. Shock tracers such as SiO and CH_3OH are reported in the bar of IC 342 (Meier & Turner 2005, Usero et al. 2006), and the results are discussed in relation to shocks in the bar. We have recently observed the bar, bar-end and spiral arm regions of NGC 3627 with ALMA (cycle-3) in the 3 mm band at a spatial resolution of ~100 pc. In this observation, we find no significant enhancement of CH_3OH in the bar. On the other hand, CH_3OH abundance is enhanced from the spiral arm to the bar-end. In this region, we find a signature that two molecular clouds are thought to be colliding to each other in a position-velocity diagram. Therefore, the CH_3OH would be evaporated from dust mantle by shock induced by the collision. Moreover, CCH and CN is found to be enhanced in the vicinity of star forming regions. These molecules are efficiently produced in the potodissociation region. From this observation, we thought that the molecular cloud scale chemical compositions reflect gas dynamics and environment in the galactic disk.

References

[1] Meier & Turner 2005, ApJ, 618, 259
[2] Nishimura et al. 2017, ApJ, 848, 17
[3] Usero et al. 2006, A&A, 448, 457
[4] Watanabe et al. 2014, ApJ, 788, 4
[5] Watanabe et al. 2016, ApJ, 819, 144
[6] Watanabe et al. 2017, ApJ, 845, 116