R15a Shock-induced Starbursts in the Nearby Merging LIRG VV 114 with ALMA

Toshiki Saito (UTokyo, NAOJ), Daisuke Iono (NAOJ, SOKENDAI), Ryohei Kawabe (NAOJ, UTokyo, SOKENDAI), and VV 114 research group

We present high sensitivity, high resolution observations of multiple HCN, HCO^+, and CH_3OH rotational lines toward the nearby bright mid-stage merger VV 114 with ALMA Band 3, 4, 6, and 7. VV 114 is known to have dust and gaseous filament (6 kpc length) across the progenitor's galaxies. The filament harbors three distinctive regions; a hard X-ray AGN, starbursting clumps, and Overlap region at the collision front. With deriving excitation conditions under LTE and optically-thin assumptions, we find that CH_3OH abundance (X_{CH_3OH}) peaks at the Overlap region, whose value is almost an order of magnitude larger than the nuclear region. This indicates that the presence of AGN and starburst activities suppress X_{CH_3OH} at the nuclear regions by strong photodissociation (i.e., efficient destruction) and/or desorption of the precursor molecule CO (i.e., inefficient production), and merger-induced shocks enhance X_{CH_3OH} at the Overlap region. We also find that Σ_{SFR} strongly correlates with line ratios and flux densities of HCN and HCO^+, indicating that star formation may govern the physical properties of dense gas ISM in the filament of VV 114, although the putative AGN position doesn't fit to this scenario. In addition, we found that the star formation efficiency doesn't simply correlate with the dense gas fraction. By adopting the turbulence-regulated star formation model, we suggest that the Overlap region has diffuser and more turbulent dense gas properties relative to dense gas at the eastern nucleus. This is consistent with the shock expranation of the X_{CH_3OH} enhancement at the Overlap region.