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ALMA view of 1 pc-scale molecular-gas structures in M33: Revealing star-formation activities in mole

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Contributed talk

Abstract:
Recent mm/sub-mm observations of molecular clouds suggest that molecular gas shows highly filamentary structure from a sub-pc to ˜100 pc scale and the collision/interaction of such filamentary structures may drive the massive star formation. Although some galactic studies found very long filamentary clouds with the length of 50-100 pc (e.g., the "Nessie" nebula) possibly formed by the galactic spiral shocks, the actual origin and the star formation therein remain to be unclear, and are hard to understand due to the heavy contamination on the Galactic plane observation.
In order to reveal the relation between the galactic scale kinematics and the formation of molecular filaments/high-mass stars, we performed ALMA observations in the 12CO(2-1), 13CO(2-1), C18O(2-1) lines and 1.3 mm continuum emission toward the three most massive giant molecular clouds (GMCs) in one of the nearest spiral galaxy M33 at an angular resolution of 0".37 (corresponding to 1.5 pc). We targeted three massive (˜10ˆ6 Mo) GMCs in M33: GMC-8 with inactive star formation; NGC 604, one of the most luminous giant HII regions in the Local Group with young stellar clusters (hereafter, the NGC 604 GMC); and GMC-16, associated with relatively small HII regions.
Our preliminary results in 12CO and 13CO data demonstrate that NGC 604 GMC and GMC-16 contain many filamentary structures, whereas GMC-8 shows less filamentary structures and significantly lower 13CO/12CO ratio compared to other two GMCs. These results indicate that the dense (filamentary) gas fraction in GMCs increases as the star formation progresses. The filamentary clouds in GMC16 are highly ordered along the North-South direction with a length of 50-100 pc, which agrees with the elongation of the spiral arm. We detect red/blue-shifted wing components possibly due to the molecular outflow from massive protostar(s) at the 1.3 mm continuum source embedded in the filament, suggesting that the galactic shock may interplay in forming the long filaments and in massive star formation. In contrast to GMC-16, the molecular clouds in the NGC 604 GMC show more complex distributions composed by much shorter (10-15 pc) filaments and/or shell/arc-like structures along HII regions. Since such morphologies cannot be explained by the spiral shocks alone, we suggest that the combination of the ionization by UV photons from the NGC 604 cluster and an external atomic gas flow promoted the evolution of the GMC.

Presenter: Dr NISHIMURA, Atsushi

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