X34a Molecular gas reservoirs within the cosmic web filaments at z=3

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Streams of cool gas along the intergalactic medium (IGM) filaments, dragged by gravity, are predicted to provide most of the gas required for the growth of galaxies and supermassive black holes (SMBHs). Molecular hydrogen is the fuel of star formation and hence observations of the molecular gas reservoir along the gas filaments is of huge importance to unveil how galaxies were formed and evolved in early cosmic times. ALMA Deep Field in SSA22 (ADF22), a $2' \times 3'$ region located in the core of the $z = 3.1$ SSA22 protocluster, hosts Ly α filaments on Mpc scales revealed by VLT/MUSE, and therefore provides an invaluable laboratory in the context. On top of the initial Band6 mosaic observations, co-spatial Band3 mosaic mapped CO(3–2) emission in the proto-cluster core. All of the sixteen brightest (1mm-selected) dusty star-forming galaxies (DSFGs) at $z = 3.09$ were detected in CO(3–2) with $L'_{\rm CO(3-2)} = 0.7 - 7.5$ [$10^{10}\,{\rm K\,km\,s^{-1}pc^2}$], which have confirmed the existence of rich molecular gas reservoirs within the cosmic web filaments. While the luminosity ratios between IR and CO(3–2) are broadly consistent with DSFGs in general fields, some proto-cluster galaxies have relatively larger CO luminosity compared to IR luminosity, which may be attributed by the plentiful gas supply from the cosmic web.