X45a ALMA observations of CO(6-5) emissions from a hyper-luminous infrared galaxy

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As predicted by the hierarchical galaxy formation model, mergers represent an important phase through which massive galaxies gain their shapes and masses as seen in the nearby universe. To obtain clues to the connections between the star formation, AGN activities, and the merging galaxies, we have studied MRC 0152-209, a hyper-luminous infrared galaxy (HyLIRG) at $z = 1.92$, using archival ALMA Cycle 4 and 6 data on the CO(6-5) line and continuum emissions. This merger has a star formation rate (SFR) of ~ 3000 $M_\odot$ yr^{-1} and total infrared luminosity of 2×10^{13} $L_\odot$. We find a high-excitation and high-velocity component west to the CO(6-5) line emission region of the north-west (NW) component that hosts a radio-loud AGN, indicating an AGN-driven outflow. The estimated molecular gas mass for the south-east (SE) component is $M_{H_2} \sim 9 \times 10^9$ $M_\odot$, which agrees with previous studies well but is concentrated in a bar-like structure elongated from SE to NW. Through the continuum emission, the high resolution (0.025") observation uncovers a radio source $\sim 0.1''$ west to the centroid of the SE component. This source coincides with the center of the radio emission observed in VLA 4, 8, and 45 GHz, suggesting an interaction between the AGN jet and the interstellar medium of the SE component. Considering the extremely high SFR, the expected gas depletion timescale is only of $\sim$ tens $\times$ Myr for each component. These results suggest that this galaxy is transitioning from a starburst HyLIRG into a massive quiescent galaxy after exhausting its molecular gas reservoirs.