

X22a Massive molecular gas companions uncovered by VLA CO(1–0) observations of the $z = 5.2$ radio galaxy TN J0924–2201

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We present VLA K-band (19 GHz) observations of the redshifted CO(1–0) line emission toward the radio galaxy TN J0924–2201 at $z = 5.2$, which is one of the most distant CO-detected radio galaxies. With the angular resolution of $\sim 2''$, the CO(1–0) line emission is resolved into three clumps, within $\pm 500 \text{ km s}^{-1}$ relative to its redshift, where is determined by $\text{Ly}\alpha$. We find that they locate off-center and 12–33 kpc away from the center of the host galaxy, which has counterparts in *HST* *i*-band, *Spitzer*/IRAC and ALMA Band-6 (230 GHz; 1.3 mm). With the ALMA detection, we estimate L_{IR} and SFR of the host galaxy to be $(9.3 \pm 1.7) \times 10^{11} L_{\odot}$ and $110 \pm 20 M_{\odot} \text{ yr}^{-1}$, respectively. We also derive the 3σ upper limit of $M_{\text{H}_2} < 1.3 \times 10^{10} M_{\odot}$ at the host galaxy. The detected CO(1–0) line luminosities of three clumps, $L'_{\text{CO}(1-0)} = (3.2\text{--}4.7) \times 10^{11} \text{ K km s}^{-1} \text{ pc}^2$, indicate the presence of three massive molecular gas reservoirs with $M_{\text{H}_2} = (2.5\text{--}3.7) \times 10^{10} M_{\odot}$, by assuming the CO-to- H_2 conversion factor $\alpha_{\text{CO}} = 0.8 M_{\odot} (\text{K km s}^{-1} \text{ pc}^2)^{-1}$. From the host galaxy, the nearest molecular gas clump labeled as clump A, is apparently aligning with the radio jet axis, showing the radio-CO alignment. Interpretations of the origin and the fate of these three clumps around TN J0924–2201 will be discussed.