X62a Removal of Molecular Gas: ALMA Observations of a Radio Galaxy at z=5.174

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We present ALMA observations of the [C II] 158 μm line and the underlying continuum emission of TN J0924−2201, which is one of the most distant known radio galaxies. The [C II] line and 1-mm continuum emission are detected at the host galaxy. The systemic redshift derived from the [C II] line is $z_{[\mathrm{C\,II}]} = 5.1736 \pm 0.0002$, indicating that the Ly$\alpha$ line is redshifted by a velocity of $1035 \pm 10\,\mathrm{km\,s^{-1}}$, marking the largest velocity offset between the [C II] and Lyα lines recorded at $z > 5$ to date. In the central region of the host galaxy, we identified a redshifted substructure of [C II] with a velocity of $702 \pm 17\,\mathrm{km\,s^{-1}}$, aligning with a model of an outflowing shell structure, consistent with the large velocity offset of Lyα. The non-detection of [C II] and dust emission from the three CO(1–0)-detected companions indicates their different nature compared to dwarf galaxies based on the photodissociation region model. Given their large velocity of $\sim 1500\,\mathrm{km\,s^{-1}}$, outflowing molecular clouds induced by the AGN is the most plausible interpretation, and they may exceed the escape velocity of a $10^{13}\,M_\odot$ halo. With the ongoing and fossil large-scale outflows, these results suggest a distinctive phase of removing molecular gas from a central massive galaxy in an overdense region in the early universe.