S24a Kiloparsec-scale Neutral Atomic Carbon Outflow in the Nearby Type-2 Seyfert Galaxy NGC 1068: An Evidence for the Negative AGN Feedback

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Active galactic nucleus (AGN) feedback is a key mechanism that possibly regulates star formation within galaxies. Studying the physical properties of the outflowing gas is thus crucial for understanding the co-evolution of galaxies and supermassive black holes. Here we report 55 pc resolution ALMA [CI] $^3P_1$–$^3P_0$ observations toward the circumnuclear disk and the starburst ring of the nearby type 2 Seyfert galaxy NGC 1068, supplemented with 55 pc resolution CO(1–0) observations. We find that [CI] within the central kpc is as comparably bright as CO. This is unusual given the typical extragalactic [CI]/CO intensity ratio of 0.15 (e.g., Jiao et al. 2019, ApJ, 880, 133). Highest ratio gas (>1) exhibits a kpc-scale elongated structure crossing the AGN position, which well coincides with the known biconical ionized gas outflow. An excellent agreement between the kinematics of the highest ratio gas and a truncated, decelerating bicone model yields that the [CI] enhancement is predominantly driven by the interplay between the gas disk and the highly inclined ionized gas outflow. This well fits to the "CO dissociation" scenario rather than the "in-situ [CI] formation" one, which prefers a perfect [CI] bicone geometry. We suggest that the high [CI]/CO ratio gas in NGC 1068 directly traces ISM in the disk that are currently dissociated by ionized gas outflow, i.e., the "negative" effect of the AGN feedback.