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High Resolution CO(3-2) and HCO+(4-3) Imaging of the Luminous Infrared Galaxy NGC 6240

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1. CO and HCN^+ in NGC 6240

We present interferometric CO(3-2), HCO+(4-3) and 870 micron continuum images of the luminous infrared galaxy NGC 6240 obtained at the Submillimeter Array (SMA). Our spatially resolved CO (3–2) and HCO+(4-3) emission peaks between the two nuclear components that are known to both harbor AGNs. The kinematical information provided by the CO (3–2) emission shows a rotating disk centered around the northern AGN and a possible face-on disk around the southern AGN, but the kinematics of gas between the two nuclei is extremely turbulent.

We analyze the physical properties of the molecular gas in nuclear starburst region using a Large Velocity Gradient (LVG) analysis. The LVG analysis performed on each 50 km/s channel using the CO(3-2), CO(1-0), HCO+(4-3), and HCO+(1-0) data cubes suggests that the peak of the molecular gas emission traced in our observations is warm (T = 20 - 200 K), dense ($n_{\rm H_2} = 10^{4.5-5.3}$ cm^{-3}) and optically thin (τ = 0.01 - 2) in the densest regions of the central 1 kpc. The average density in the central 2 kpc is $n_{\rm H_2} \sim 10^{4.0}$ cm^{-3}, and the gas is highly turbulent there ($\Delta v_{\rm FWZI} \sim 900$ km s^{-1}). The derived molecular gas mass in the central 0.5 kpc (1.5×10^9 M$_\odot$) is consistent with the mass derived from previous CO (2–1) observations.

We propose that 3.5×10^8 M$_\odot$ of isolated CO (3–2) emission seen west of the northern disk may be a direct consequence of gas outflow from the central AGN, which is a phenomenon seen in the latest numerical simulations that include black holes. Piecing all of the information together, the central region of NGC 6240 harbors 2 AGNs, $\sim 10^9$ M$_\odot$ of molecular gas mass, 5×10^7 M$_\odot$ of dust mass, and have evidence of inflow and outflow activity.