S19b Gas Dynamics in the LINER Galaxy NGC 5005

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We report high-resolution CO(1–0) observations in the central 6 kpc ($1'$) of the LINER galaxy NGC 5005 with the Owens Valley Radio Observatory millimeter array. Molecular gas is distributed in three components– a ring at a radius of about 3 kpc, a strong central condensation, and a streamer to the northwest of the nucleus but inside the 3 kpc ring. The ring shows systematic noncircular motions, with inward velocities of about 50 km s^{-1} on the minor axis. The central condensation is a disk of ~ 2 kpc diameter with a central depression of ~ 100 pc diameter. This disk has a molecular gas mass of $\sim 2 \times 10^9 M_\odot$; it shows a steep velocity gradient and a large velocity range (~ 750 km s^{-1}) 30% larger than the velocity width of the rest of the galaxy. The streamer between the 3 kpc ring and the nuclear disk lies at a radius of ~ 1 kpc and on a straight dust lane seen in the optical. If this material is in the plane, its motion is offset by up to ~ 150 km s^{-1} from galactic rotation.

We suggest an optically unseen stellar bar lying within the 3 kpc ring can explain the observed gas dynamics. This bar is expected to connect the nuclear disk and the ring along the position angle of the northwest stream. A position-velocity cut in this direction contains features which match the characteristic motions of gas in a bar potential. Our model indicates that gas in the northwest stream is on an x_1 orbit on the bar's leading edge; it is falling into the nucleus with a large noncircular velocity, and will eventually contribute $\sim 2 \times 10^8 M_\odot$ to the nuclear disk. We associate the disk with an inner 2:1 Lindblad resonance and attribute its large linewidth to favorably oriented elliptical orbits rather than a large central mass. The 3 kpc ring is likely an inner 4:1 Lindblad resonance ring– or a pair of tightly wound spiral arms– arising at the bar ends. Both scenarios can explain the apparent noncircular motions in the ring.