The Physical Conditions and Dynamics of the Interstellar Medium in the Nucleus of M83: Observations of CO and C I

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ABSTRACT

This paper presents [C I], ^{12}CO J=4−3, and ^{12}CO J=3−2 maps of the barred spiral galaxy M83 taken at the James Clerk Maxwell Telescope. Observations indicate a double peaked structure which is consistent with gas inflow along the bar collecting at the inner Lindblad resonance. This structure suggests that nuclear starbursts can occur even in galaxies where this inflow/collection occurs, in contrast to previous studies of barred spiral galaxies. However, the observations also suggest that the double peaked emission may be the result of a rotating molecular ring orientated nearly perpendicular to the main disk of the galaxy. The ^{12}CO J=4−3 data indicate the presence of warm gas in the nucleus that is not apparent in the lower J CO observations which suggests that ^{12}CO J=1−0 emission may not be a reliable tracer of molecular gas in starburst galaxies. The twelve [C I]/^{12}CO J=4−3 line ratios in the inner $24'' \times 24''$ are uniform at the 2σ level which indicates that the ^{12}CO J=4−3 emission is originating in the same hot photon-dominated regions as the [C I] emission. The ^{12}CO J=4−3/J=3−2 line ratios vary drastically within the nucleus with the higher line ratios occurring away from peaks of emission along an arc of active star forming regions. These high line ratios (>1) likely indicate optically thin gas created by the high temperatures caused by star forming regions in the nucleus of this starburst galaxy.

Subject headings: galaxies: barred spiral — galaxies: individual (M83) — galaxies: ISM — ISM: molecules