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SUPPLYING GAS FOR NUCLEAR STAR FORMATION: THE CENTRAL MOLECULAR SPIRAL OF IC 342

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INTRODUCTION

IC 342 is a large nearby (1.8Mpc) spiral galaxy undergoing a moderate nuclear starburst. Previous maps of the inner arc minute in ^{13}CO (1$\rightarrow$0) show that the nuclear molecular gas forms spiral arms approximately 500 pc in extent in a density wave pattern (Turner & Hurt, 1992).

OBSERVATIONS

We observed IC 342 in the 2.6 mm ^{12}CO(1$\rightarrow$0) transition with 2.8$''$ resolution at the OVRO Millimeter Interferometer. Spectral line data were collected in two 32 channel filterbanks, one at 5 MHz = 13.6km s^{-1} resolution (435 km s^{-1} total) and the other at 1 MHz = 2.72 km s^{-1} resolution (87 km s^{-1} total).

Five overlapping fields were observed. The phase center of the central field was at $\alpha = 03^{h}41^{m}57^{s}.0$, $\delta = +67^{d}56'30''$ with the other four offset by $\pm 30''$ and $\pm$ 60$''$ in declination. The central velocity at channel 17 corresponds to a V_{lsr} of 28.5 km s^{-1}. The individual 5 MHz channels were deconvolved using CLEAN and mosaicked. Integrated intensity and intensity-weighted velocity moment maps were produced from the channel map mosaics.

RESULTS

The ^{12}CO emission takes the form of a kinked bar or very open 2-arm spiral which is continuous out to a distance of 800 pc (90$''$) from the center. Fainter, patchy emission out to the edges of the field, where the primary beam response is low, suggests that the spiral pattern continues out to $\gtrsim$ 1 kpc. Also visible are symmetric spurs of molecular emission suggesting more tightly wound spiral arms to the concave side of the open arms. These spurs extend from the open arms beginning at $\sim$20$''$ from the optical nucleus.

Figure 1 is an overlay of the ^{12}CO integrated intensity contours on a gray scale plot of the Hα emission (J. Young). The CO emission traces the Hα arms, offset 50-100 pc (5-10$''$), as would be expected if the star formation is due to compression of the molecular gas by a trailing spiral density wave. We have also

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overlaid the CO on a near-IR SQIID image (R. Hurt). The spiral structure in the CO is correlated with lanes of near-IR extinction.

Figure 2 is a plot of the isovelocity contours for the CO. The motion is nearly solid-body in the inner ~20 ″, beyond which the contours become nearly parallel to the molecular ridge, consistent with a substantial radial flow.

We calculated the de-projected tangential and radial velocities from cuts across the velocity moment map along the major and minor axis, respectively. In our analysis of the tangential component, we included a value from single-dish CO work by Young & Scoville (1982). We computed a best-fit analytic function for each component. Figure 3 is a plot of both components and the fits. We combined the motions described by the functional fits in an axisymmetric model, which provided a fairly good fit to the gross features of the velocity field. An axisymmetric model is an over-simplification of the true situation; however, since the region mapped is a fairly narrow slice through the full 2π velocity field, an axisymmetric model may be a locally good approximation at large radii. More sophisticated models of streaming along a shock front and elliptical streaming should be investigated.

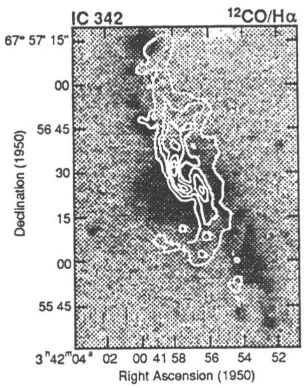


Figure 1

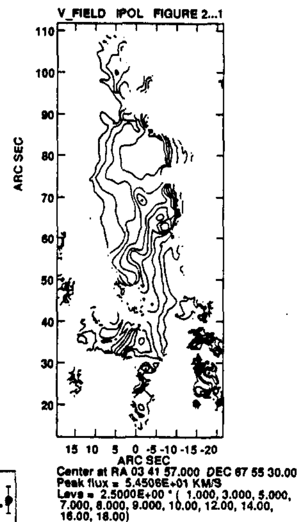
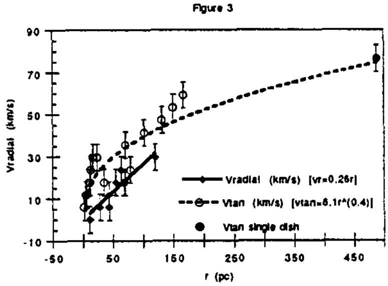


Figure 3



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