

Aperture Synthesis Observations of the Molecular Ring in the Galactic Center

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ABSTRACT

We report 88 GHz aperture synthesis observations of HCN $J=1\rightarrow 0$ emission and absorption in the central 5 pc of the Galaxy. The data, taken at 5" to 10" spatial and 4 km s⁻¹ spectral resolution with the Hat Creek mm-interferometer, show a complete, clumpy ring of molecular gas surrounding the ionized central 2 pc of the Galaxy. The ring is the inner edge of a larger disk extending to about 5 pc. Comparison with sub-mm (Harris et al., (1985) and FIR (Genzel et al., 1985) line data suggests that the HCN 1-0 line is slightly optically thick and originates in subthermally populated gas. The clumpy distribution of line emission reflects a combination of hydrogen volume and column density variations.

The new data clearly show a close physical relation between the molecular and the ionized gas in the central cavity. The "western arc" (Lo and Claussen, 1983; Serabyn and Lacy, 1985) appears to be the ionized inner surface of the molecular ring, and the "northern arm" and "bar" may be streamers of ionized gas falling from the ring toward the center.

The dominant large scale velocity pattern of the majority of the molecular gas in the inner 5 pc is rotation. No overall radial motion of the ring greater than about 20 km s⁻¹ is apparent. The rotation is perturbed in several ways; 1) there is a very large local velocity dispersion, 2) the ring shows changes in position angle and inclination (warps), 3) there is a bright, redshifted cloud which appears to be located in the western part of the ring but does not participate in the rotation. These characteristics and the high degree of clumpiness indicate a non-equilibrium configuration of short ($< 10^4$ to 10^5 y) dynamical lifetime. The warping and tilting of the structure and the short dynamical lifetime make an accurate determination of "equilibrium" rotation velocity uncertain.

References

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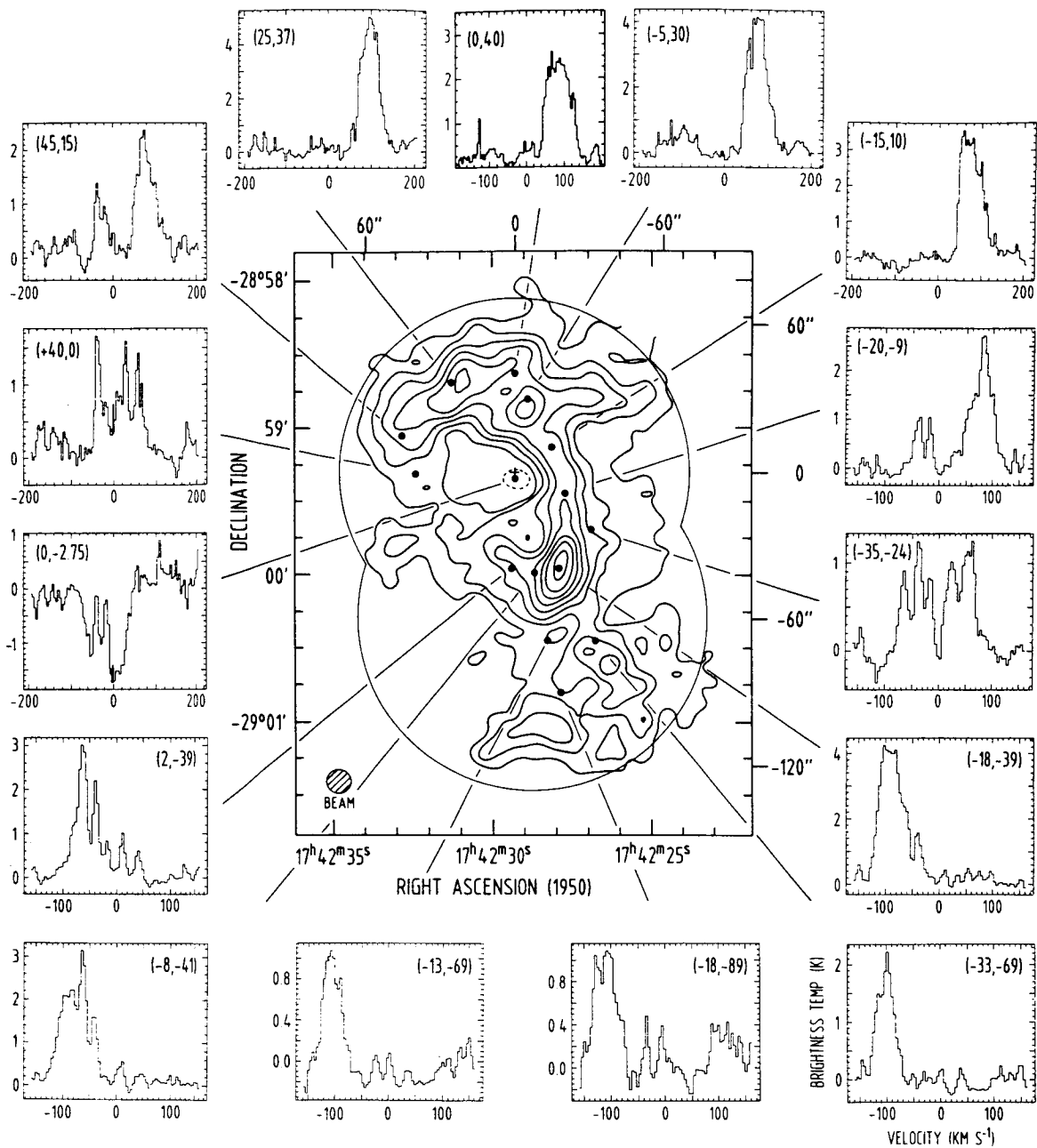


Fig. 1: Velocity integrated HCN 1-0 map (-150 km s^{-1} to 150 km s^{-1} , CLEAN ed) and selected spectra. The spatial resolution is $10.8'' \times 9''$ (FWHM, R.A. \times Dec.), the spectral resolution is 4.23 km s^{-1} . Continuum emission has been subtracted. The contour units on the map are 0.2 K.