CO OBSERVATIONS OF M51

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We present observations, which are part of an ongoing investigation, of the CO (J=1-0) emission in the spiral galaxy M51. The spectra were obtained in a beamswitched on-on mode with the Onsala 20 m antenna (beam size ∿33"), equipped with a cooled mixer and a 512×1 MHz multichannel receiver, and are shown in Figure 1. The inset diagram shows the observed positions superposed on the optical outline of the galaxy. With the present signal-to-noise ratio there is no evidence for an arm-interarm intensity contrast. This is even more apparent in integrated intensity. This result agrees with the lower resolution findings of Rickard et al. (1981). We have observed ^{13}CO in one position (22" south of the center). The ^{13}CO to ^{12}CO ratio, ∿0.1, agrees with Bell results from observations with a 1!7 beam (Encrenaz et al. 1979).

In the central region of the galaxy we note differencies in velocity dispersion along the east-west and north-south axes. The spectra along the east-west axis through the center are all broad (∿150 km s^{-1}), while the spectra along the north-south axis are narrow (∿40 km s^{-1}), with a sharp velocity shift (∿125 km s^{-1}). The average of the four spectra offset 22" from the central position is an almost exact synthesis of the observed spectrum here, which may indicate a central neutral gas depression. It seems impossible to interpret these data in terms of galactic rotation only. An elliptical velocity pattern over an extended region (∿20"×60") seems to be the "simplest" explanation and might point at a bar driven spiral density wave picture (cf. Lin and Roberts 1981). The observed ionization enhancement and broad emission lines in the M51 nucleus, indicating a nonstellar source of radiation (Rose and Searle 1982), may be of interest in this context. Goad et al. (1979) have observed more complex, small-scale, structure in the ionized gas.

In Figure 2 we compare the CO velocity structure along the north-south axis with ionized gas velocities derived by Goad et al. (1979) and the HI velocity structure of Shane (1975). There appear to be some systematic kinematic differencies between CO and the ionized gas. The HI gas shows the largest dispersion, and appears to cover the velocity pattern of both the ionized gas and the CO molecular cloud ensemble.

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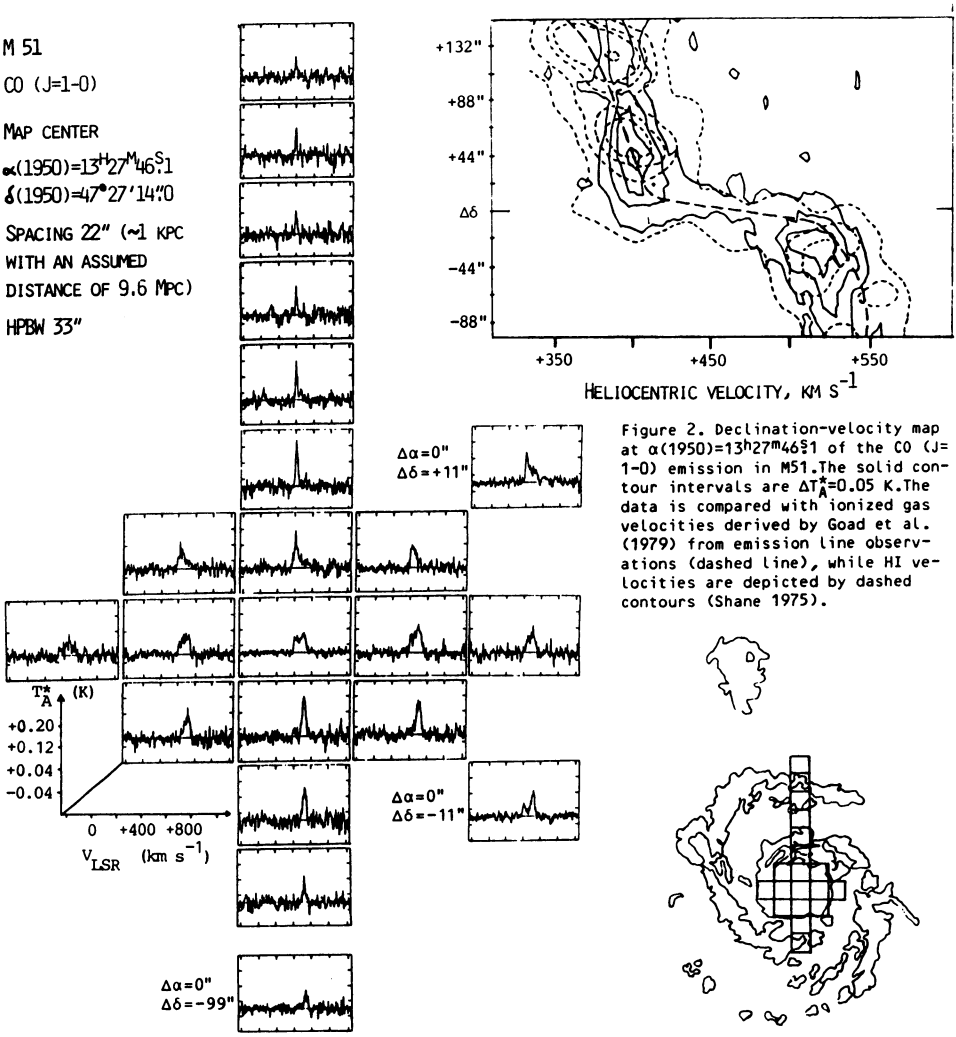

Figure 2. Declination-velocity map at $\alpha(1950)=13^h27^m46^s1$ of the CO (J=1-0) emission in M51. The solid contour intervals are $\Delta T_A^*=0.05$ K. The data is compared with ionized gas velocities derived by Goad et al. (1979) from emission line observations (dashed line), while HI velocities are depicted by dashed contours (Shane 1975).

Figure 1. CO emission in M51. The inset diagram shows the position of the spectra on a tracing of the optical outline of the galaxy. The intensity scale is given in antenna temperature corrected for radome and atmospheric attenuation. The main beam efficiency is 0.3 and the moon efficiency is 0,6. To get from V_{LSR} to heliocentric velocity, subtract 11.7 kms^{-1}.

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