CO IN M82 AND OTHER MILDLY ACTIVE GALAXIES

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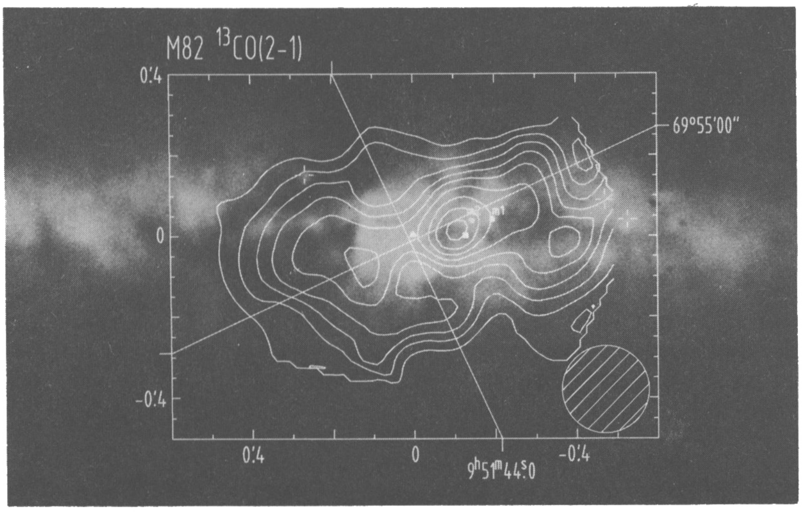
A large project of studying various transitions and isotopic species of CO in M82 has been carried out with the 30-m IRAM radio telescope. A 1'.6×1'.0 area was mapped in ^{12}CO(2→1) with 13" resolution (Loiseau et al., 1988a). The purpose of these observations was to obtain high signal-to-noise, high resolution data for comparison with the ^{12}CO(1→0) observations of Nakai et al. (1987). A ^{13}CO(2→1) observation covered the central 1'.0×0'.7 region (Loiseau et al., 1988b) and allowed to establish the velocity field of CO in the inner nuclear region. The position angle of the rotation axis of ^{13}CO is aligned with the optical rotation and at some 30° relative to the ^{12}CO velocity field. The ^{13}CO map also shows the existence of clumped emission in the central region. All data show the rotating



molecular ring. At some selected points (nucleus, major axis) ^{12}CO/^{13}CO ratios in both the (1→0) and (2→1) transition have been determined. The earlier suggestion that optical depth plays an important role in M82 has been confirmed. Variations of optical depth have been determined in the

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area where common data is available. More recently, $C^{18}O$ studies of M82 have started (H.P. Reuter, private communication) with the aim of understanding both the optical depth and isotopic ratios in M82. The optical filaments in the nuclear area of M82 suggest a magnetic field along the minor axis. Radio continuum studies of M82 (Klein et al., 1988) indicate that this galaxy has the highest magnetic field of any galaxies. The casual connection between the rotating torus (CO, HI, etc.) and a poloidal magnetic field has been investigated (Lesch et al., 1988).

From this consideration we selected a number of mildly active galaxies and began investigations in CO and radio continuum. The galaxy M104 has a VLBI source in the nucleus, a radio disk and polarised emission which is aligned in the poloidal direction at the nucleus (Bajaja et al., 1988). A detection of CO in this early-type galaxy has been made (H.P. Reuter, M. Krause), but at a level of only ~50 mK so that the question of a rotating torus could not be definitely answered. Another candidate galaxy which has been investigated is NGC 1808. The optical filaments are clearly along the minor axis and an active nucleus is known to be present (Sersic and Pastoriza, 1965). Recent VLA observations (M. Dahlem, private communication) showed extended jets originating in the nucleus. Also a system of HI absorption was detected. SEST observations (R.S. Booth et al., private communication) again indicate a rotating ring of CO. The southern galaxy NGC 4945 is known to be a very active object. It is a source of dense HI, H_2CO, OH and CN emission. It is also a megamaser galaxy. A recent radio continuum survey of NGC 4945 (Harnett et al., 1988) has shown the existence of two polarisation maxima above the disk, symmetrically disposed about the nucleus. This galaxy has been recently extensively mapped with the SEST telescope (J.B. Whiteoak, M. Dahlem et al., private communication) in $^{12}CO(1\rightarrow0)$. The search for ring structure will be continued in the $(2\rightarrow1)$ transition.

The study of a number of mildly active galaxies indicate that there may be a casual relation between poloidal magnetic fields, radio continuums jets along the minor axis and rotating torus ring structures (CO, HI, OH, etc.) in the nuclei of such galaxies.

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