

PECULIAR CO DISTRIBUTION IN ACTIVE SPIRAL GALAXIES: NCG4258 AND CIRCINUS

M. KRAUSE

*Max-Planck-Institut für Radioastronomie
Auf dem Hügel 69, D-53121 Bonn, Germany*

N. NEININGER

*Radioastronomisches Institut der Universität Bonn
Auf dem Hügel 71, D-53121 Bonn, Germany*

M. ELMOUTTIE AND K.L. JONES

*The Physics Department of the University of Queensland
QLD4072, Australia*

AND

R.F. HAYNES

*The Australia Telescope National Facility
CSIRO, P.O. Box 76, NSW 2121, Australia*

1. Introduction

NGC4258 and Circinus are both nearby spiral galaxies with active galactic nuclei which show high velocity water maser emission and Seyfert 2 characteristics. Both show radio emission perpendicular to the normal spiral arms which seem to be related to the nuclear activity (van der Kruit *et al.*, 1972; Harnett *et al.*, 1990). In NGC 4258 they coincide with the inner part of the rapidly rotating nuclear disk as expected for nuclear jets. Due to the strong misalignment of the nuclear disk plane with the galaxy's disk plane the jets pass the galactic disk. Molecular gas in NGC 4258 has only been detected in the nucleus and along the H α jets up to a distance of 2 kpc from the nucleus (Krause *et al.*, 1990).

2. Observations

We observed NGC 4258 in $^{12}\text{CO}(1-0)$ with the Plateau de Bure interferometer (PdBI) in its compact configuration in 5 fields along the H α jets using

the mosaicing technique. In total we observed an area of $100'' \times 40''$, with a uniform sensitivity along the major axis of the oval. In order to correct the data for 'missing spacings', we *combined the PdB data* in the UV plane *with single dish data* obtained recently with the 30-m telescope at Pico Veleta by Cox and Downes (1997). The angular resolution of the final maps is $4''.6 \times 3''.3$.

The Circinus galaxy was observed at the Swedish ESO Submillimeter Telescope (SEST) in $^{12}\text{CO}(1-0)$ along a rectangular grid pattern centered at the galaxy's optical core along and perpendicular to the radio major axis with a cell size of $20''$. The angular resolution of the data is $45''$.

3. Discussion

The CO in *NGC 4258* follows two ridges along the $\text{H}\alpha$ emission with a total extent of $100''$ (3kpc). The width of each ridge is about $10''$. They are symmetrically located relative to the jet axis with a region of minor CO emission in between. Contrary to previous interpretations the CO does not outline 'walls' around the $\text{H}\alpha$ jets and collimates it, but rather it seems to be mixed (in location and in velocity) with the $\text{H}\alpha$ gas. Whereas most of the CO gas takes part in the normal disk rotation, there is a steep velocity gradient of about 300 km/s along the jet axis. This strongly suggests that the *CO gas is rotating around the jet axis*. The sense of rotation is equal in the northern and southern jet and equal to that of the rapidly rotating nuclear disk and the helical structure in $\text{H}\alpha$ as found by Cecil *et al.* (1992). Hence, our observations support the hypothesis that the molecular gas (and probably also the $\text{H}\alpha$ gas) is *entrained* disk material which has been partly ionized by shocks and which is rotating around the jet axis along helices.

We have detected strong CO emission in *Circinus* larger in extent than the radio emission but much smaller than the HI phase. It is concentrated towards the nuclear region. Our data suggest the presence of a *central molecular disk or ring* with a radius of 300 ± 50 pc rotating with a velocity of about 200 km/s around a central source which is responsible for a bipolar outflow. The integrated CO map shows a spur along the northern minor axis, possibly related to the outflow.

References

- Cecil G., Wilson A.S., Tully R.B. (1992) *ApJ*, **390**, 365
 Cox P., Downes D. (1996), *ApJ*, **473**, 219
 Harnett J.I., Whiteoak J.B., Reynolds J.E., Gardner F.F., Tzioumis A., 1990, *MNRAS*, **244**, 130
 Krause M., Cox P., Garcia-Barreto J. A., Downes D. (1990) *A&A*, **233**, L1
 Van der Kruit P.C., Oort J.H., Mathewson D.S. (1972), *A&A* **21**, 169