

CO OBSERVATIONS OF THE 30-DORADUS REGION USING SEST

R.S. BOOTH & L.E.B. JOHANSSON
*Onsala Space Observatory
Chalmers University of Technology
S-439 00 Onsala
Sweden*

ABSTRACT. Using the Swedish-ESO Submillimetre Telescope, we have mapped the CO (1-0) emission in two small areas of the LMC near 30 Dor. Some 20 molecular clouds have been identified and analysed. Cloud masses are calculated assuming virial equilibrium and the relationship between mass and CO luminosity is discussed.

1. The observations

The Magellanic Clouds are an important target for the Swedish-ESO Submillimetre telescope (SEST). Its 15m aperture gives a beam-width of 44 arcsec at 115 GHz, representing a linear resolution of 10 pc at the distance of the LMC. Thus, for the first time we are able to observe individual molecular clouds in a nearby galaxy. This dramatic increase in resolution is demonstrated in Figure 1 which shows the contour map of Cohen *et al.* (1988) together with the maps of the regions observed by us (Johansson *et al.*, 1989).

2. Molecular cloud parameters

We have isolated 23 clouds in these observations. Their half power diameters range in scale from about 5 pc to 30 pc. The molecular masses of the clouds have been calculated, assuming virial equilibrium. This assumption may be justified from the approximate relationship between CO velocity dispersion σ_V and cloud size, σ_D , $\sigma_V = \sqrt{\sigma_D}$ (Johansson *et al.*, 1989; Solomon *et al.*, 1987). In this way we find that the molecular masses of the clouds range from 4 to $200 \cdot 10^3 M_\odot$.

For giant molecular clouds in the Galaxy, Solomon *et al.* (1987) have found an empirical relation between virial mass and CO luminosity which they claim may be used to determine the mass of molecular gas in external galaxies from CO observations. Maloney and Black (1988) and Elmegreen (1989) have argued that metallicity and uv radiation flux may affect this conversion.

In view of this discussion, and concerning the low metallicity of the LMC, it is interesting to plot the CO luminosity as a function of virial mass for the LMC clouds identified in this work. The result is shown in Figure 2 - the relationship found by Solomon *et al.* is plotted as a solid line on the figure. Figure 2 implies that the conversion between L_{CO} and M_{H_2} is different, on average by a factor of 2 at most, relative to the Galaxy. While at first sight, this result favours a constant conversion from galaxy to galaxy, Johansson *et al.*, through observations of both the (1-0) and (2-

1) rotational lines of ^{12}CO and ^{13}CO , find that the ^{12}CO in the LMC has an optical depth $\tau \approx 1$. They therefore suggest that the CO clouds may indeed have suffered photodissociation and thus the volume occupied by detectable CO as a fraction of the total molecular volume (defined by the H_2) may be smaller in this low metallicity system. Hence, the conversion factor from CO to H_2 mass may be somewhat greater than 2.

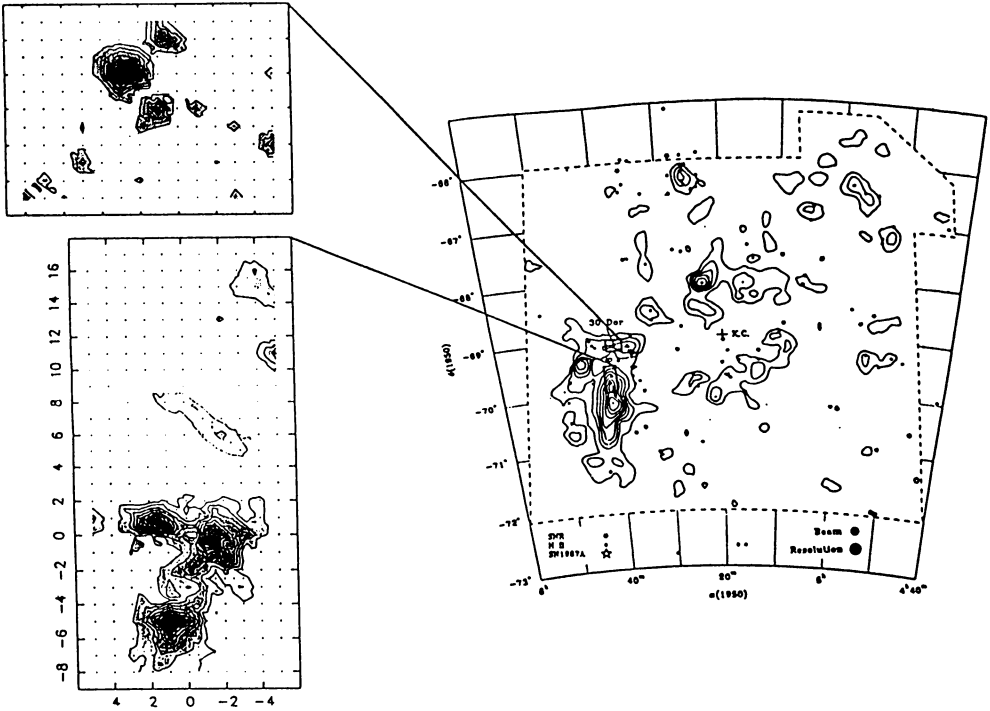


Figure 1. A map of the CO in the Large Magellanic Cloud (Cohen *et al.*, 1988) showing the regions observed by Johansson *et al.* (1989) with the SEST telescope.

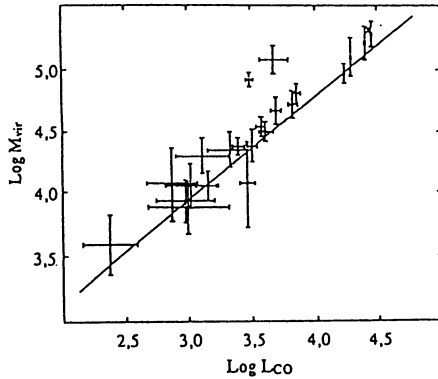


Figure 2. A plot of L_{CO} v. virial mass for individual CO clouds in the LMC. The Galactic relation (Solomon *et al.*, 1987) is shown as a solid line.

References

- Cohen, R.S., Dame, T.M., Garay, G., Montani, J., Rubio, M. and Thaddeus, P. (1988), *Astrophys. J.* **331**, L95.
- Elmegreen, B.G. (1989), *Astrophys. J.* **338**, 178.
- Johansson, L.E.B., Booth, R.S., Murphy, D., and Olberg, M. (1989), In *Submillimetre Astronomy*. Eds. G.D. Watt and A.S. Webster. Kluwer Academic Publishers.
- Maloney, P. and Black, J.H. (1988), *Astrophys. J.* **325**, 389.
- Solomon, P.M., Rivolo, A., Barrett, J. and Yahil, A. (1987), *Astrophys. J.* **319**, 730.