MOLECULAR LINE OBSERVATIONS IN THE LARGE MAGELLANIC CLOUD

F.F. Gardner
Division of Radiophysics, CSIRO, Sydney, Australia

This is a preliminary report on on-going observing programs in the LMC using CSIRO facilities. Molecular-line observations made with the 64-m Parkes telescope include OH at 18 cm (Whiteoak & Gardner 1976b; Caswell & Haynes 1981), H_2CO at 6 cm (Whiteoak & Gardner 1976a) CH at 9 cm (Whiteoak et al. 1980) and H_2O at 1.3 cm with beamwidths between 13' and 1'.7 arc; observations of HCO^+ at 3.4 mm (Batchelor et al. 1981) and CO at 2.6 mm have been made with the 4-m Epping telescope.

The CO survey with the 4-m telescope is still preliminary, and this note will only discuss results for positions where other molecules have been detected. At the 4 H_2O maser positions, N105A, 30 Dor, N160A and N159 (Whiteoak et al. 1983; Scalise & Braz 1981), CO was detected with corrected antenna temperature values (T_a^*) between 0.6 and 1.5 K and with widths of 5.5-8.0 km s^{-1}. It was not found ($\leq$0.25 K) at a dark cloud position 4'.5 NW. of N160A, where Israel et al. (1982) reported 1.3 mm CO emission with T_a^* = 1.1 K. CO, H_2O and radio recombination velocities for the HII regions (the peaks of which were within ~1' of the maser positions) were in close agreement. For N159 observations made with positional offsets of ±1'.5 in right ascension and declination showed that the cloud size was 2'.1±1'.0 and the corrected peak intensity ~4 K.

In his review talk 'Molecules and Dust in the Magellanic Clouds', F.P. Israel demonstrated the generally low intensity of CO emission from the Clouds as compared to the Galaxy and suggested that this might result from the observed low dust/gas ratio, which is probably a consequence of the lower metal abundances of the Clouds. For the other molecules the information available is more limited. H_2O masers have been found in 4 and OH masers in 2 of the sources, N105A and N159; the other lines have been found in 1 source only, N159. The comparison of the masers in the LMC and the Galaxy is limited by the small numbers and selection effects. Whiteoak et al. (1983) note that the luminosities of their 3 H_2O masers (out of 10 HII regions observed) were similar to the average for H_2O masers in the Galaxy ($\sim 10^{29.5}$ erg). The stronger OH 1665 MHz source N105A had an observed intensity of 0.76 Jy equivalent to 2×10^3 Jy for a source 1 kpc distant. Haynes & Caswell (1981) note that only 2 (from a sample of 40 galactic Type I masers) have an intrinsic luminosity greater than the source in N105.

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The results for the non-masering lines are summarized in Table 1. A comparison with the Galaxy is limited by uncertainties in the beam dilution for N159. With the most favourable estimates (see references given earlier) the N159 values for OH, H_2CO and CH could equal the average values in the Galaxy. For HCO^+ the ratio $T_a^*(HCO^+)/T_a^*(CO)$ observed with similar beams, 0.18/1.45 = 0.12, is close to the average ratio in the Galaxy. Since N159 must be one of the most massive molecular clouds in the LMC (as discussed in detail by Israel et al. 1982), it is likely that the LMC is generally deficient in the 4 molecules in Table 1. However, the fact that the abundances of these molecules relative to CO are similar for the LMC and the Galaxy would argue against CO abundance being determined primarily by the UV intensity. As discussed by Israel (this volume), CO destruction by UV should be considerably greater in the LMC because of the greater UV penetration of the clouds in the LMC as compared with the solar neighbourhood. However, it is probable that molecular destruction by the UV would be more effective for non-CO molecules than for CO.

Table 1. Molecular Line Observations towards N159

Molecular Line	Beamwidth ('arc)	N159 Value[a]	Typical Galactic Value[a]
OH: 1.667 GHz	12.4	L/C = -0.013	L/C ~-0.1-0.2
H_2CO: 4.83 GHz	4.3	L/C = -0.014	L/C ~-0.07
CH: 3.26 GHz	6.4	0.013 Jy; L/C = 0.006	L/C ~0.025
3.33 GHz		" "	
HCO^+: 89 GHz	3.3	0.18 K T_a^*	~2.0 K T_a^*

[a] L/C, ratio of line/continuum intensity.

A comparison of molecular concentrations and excitation for the two galaxies will clearly assist our understanding of molecular formation and destruction processes. There is an obvious need for improved and considerably more extensive molecular data for the Magellanic Clouds.

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