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MOLECULAR CLOUDS IN THE LARGE MAGELLANIC CLOUD

Mónica Rubio

Departamento de Astronomía
Universidad de Chile

RESUMEN. Se ha detectado emisión de monóxido de carbono proveniente de más de 30 regiones en la Nube Grande de Magallanes. Un análisis preliminar sugiere que las nubes moleculares de esta galaxia serían de menor tamaño que las de la Vía Láctea.

ABSTRACT. CO emission has been detected from more than 30 regions in the Large Magellanic Cloud (LMC). A preliminary analysis suggest that the LMC molecular clouds may have smaller sizes than those found in our Galaxy.

Key words: GALAXIES-MAGELLANIC CLOUDS — INTERSTELLAR-MOLECULES

A complete survey of the 2.6mm CO(J=1→0) emission line of the Large Magallanic Cloud (LMC), done with an angular resolution of 8.8 arcmin and at an r.m.s. noise level of 0.05 K, has been completed. The observations were made with the Columbia Southern-Millimeter-Wave Telescope at Cerro Tololo from 1983 January through 1985 August. This survey, covering completely the LMC in a 6°x6° area, represent the first systematic study of the molecular content of this galaxy.

We have detected CO emission toward the LMC from more than 30 regions schametically shown in figure 1. (A catalogue of the LMC CO sources will be published elsewhere, Rubio et al. 1986). These complexes appear well correlated with continuum sources at 6 cm (McGee and Newton 1972) and are projected toward regions where the neutral hydrogen column density is greater than 10^{21} at cm^{-2} (Rohlfs et al. 1985, McGee and Milton 1964). The largest CO cloud (source 29), located 45' south of 30 Doradus, that also shows the strongest CO emission, is proyected, in the direction where the HI column density is the largest (Rohlfs et al. 1985). The central and southern region of this cloud (declination < -70°) are not associated with either radio continuum sources at 6 cm (McGee and Newton 1972) nor optical HII regions (Davies et al. 1976), suggesting that star formation has not taken, or only recently took, place there.

One of the main characteristics of the CO emission in the LMC is the low antenna temteratures, T_A^*, measured. For galactic molecular clouds, typically T_A^* (^{12}CO) = 5 K. The strongest line detected in the LMC has T_A^* = 0.48 K, however most of the detections are about 0.2 K. The weakness of the CO emission has also been observed in other irregular galaxies (Elmegreen et al. 1980, Morris and Rickard 1982). Several explanations have been given to interpret these results such as i) lower heating rate of the interstellar clouds and thus lower CO temperatures; ii) lower CO abundances; and iii) higher gas to dust ratio.

We have made ^{13}CO observations toward the LMC in three positions exhibiting strong ^{12}CO emission, two in Complex 9 and one in Complex 5. ^{13}CO emission was detected in each of those positions. The ^{12}CO to ^{13}CO ratio of antenna temperature is ∿ 0.1, about one half the Galactic disk value (Solomon and Sanders 1979). A preliminary analysis of these observations indicate that in order to understand, the observed $T_A^*(^{13}CO)/T_A^*(^{12}CO)$ ratio, the $|^{13}CO/H_2|$ ratio in the LMC should be smaller than the galactic value of 2×10^{-6} (Dickman 1978), which is consistent with the lower abundance of C and O found in the LMC (Dufour 1984). In addition, our data imply that, in one beam, we are observing either one giant molecular cloud with a radius not larger than R ∿ 25 pc and a mass of $M = 1.6 \times 10^5$ $M_\odot$, or a larger number of molecular clouds with smaller sizes but the same mass (for example 8 clouds with R ∿ 10 pc). Comparison with CO observations done with higher angular resolution or in the J=2→1 emission line (Huggins et al.

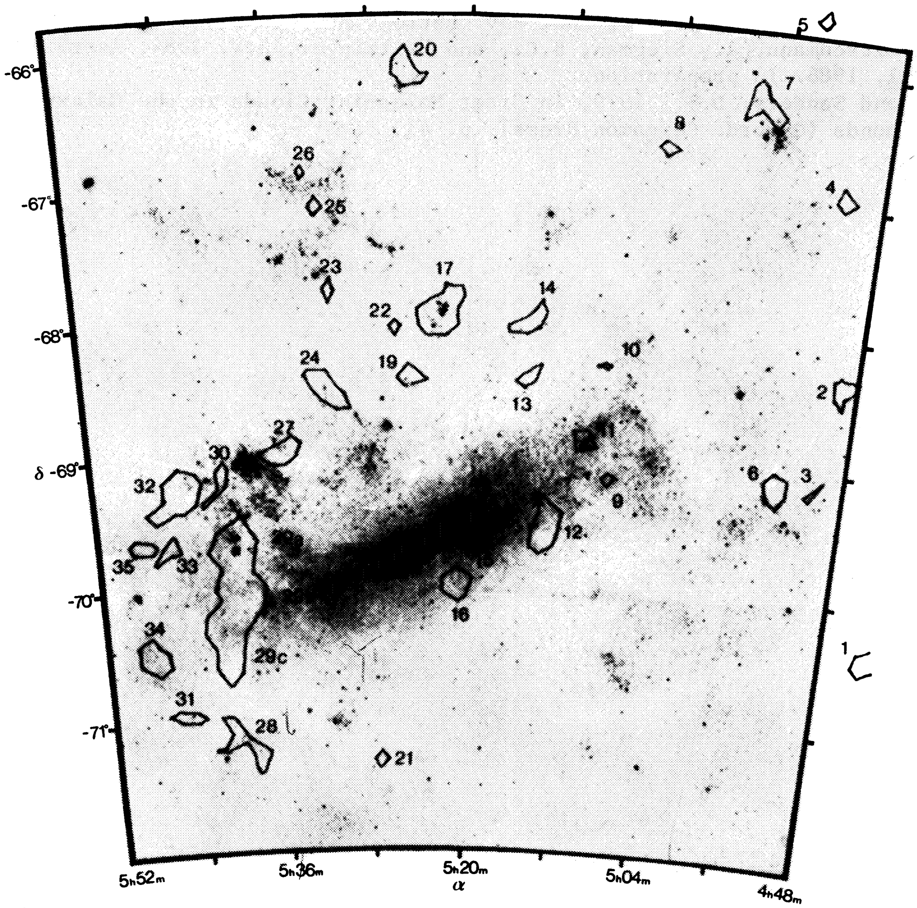

Fig. 1. Sketch of the regions where CO has been detected in the Large Magellanic Cloud. This map has been obtained by integrating all the CO emission in velocity intervals of 13 km s^{-1} and covers from 200 km s^{-1} to 354 km s^{-1} in velocity (V_{LSR}). The shown contour represent emission at 0.65 K km s^{-1}.

1975, Israel et al. 1986) suggest that the LMC molecular clouds may have smaller sizes than those found in our Galaxy. Thus, the weakness of the CO emission can be explained in terms of beam dilution effects.

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Mónica Rubio: Depto. de Astronomía, Universidad de Chile, Casilla 36-D, Santigo de Chile.