THE LARGEST MOLECULAR COMPLEXES IN THE FIRST GALACTIC QUADRANT

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The CO emission within a few kiloparsecs of the Sun is dominated by a small number of very large molecular complexes, including those associated with the Orion Nebula (Thaddeus 1982), M16 and M17 (Elmegreen, Lada, and Dickinson 1979), and NGC7538 (Cohen et al. 1980). These complexes have masses from several 10^5 to 10^6 $M_\odot$ and are generally very well-defined objects. They are also well endowed with HII regions, stellar clusters and associations, masers, and other Population-I objects whose distances can be measured. The complexes are thus valuable probes of the large-scale structure of the Galaxy.

We have used the Columbia University CO survey of the first galactic quadrant (Cohen et al. 1980, Dame 1983) to determine the locations and physical properties of the largest molecular complexes in the inner Galaxy. Masses for the complexes were determined from their velocity-integrated CO luminosities by assuming a proportionality between integrated ^{12}CO emission and H_2 column density: $N(H_2)/W(CO) = 2 \times 10^{20}$ cm^{-2} K^{-1} km^{-1} s (Lebrun et al. 1983). Distances to most of the complexes were determined kinematically, the distance ambiguity being resolved using a variety of methods; for most complexes several methods were applicable and gave consistent results. Within the range of our survey (ℓ=12°-60°) 19 complexes were detected with masses greater than 5×10^5 $M_\odot$. We estimate that roughly 100 such complexes exist in the Galaxy within the solar circle.

As figure 1 shows, the largest complexes delineate the Sagittarius Arm over more than 120° of galactocentric azimuth with remarkable clarity -- probably better in fact than any other Population-I tracer. The 15 large complexes which we identified in the arm have a total mass of 16×10^6 $M_\odot$ and an average spacing of about 1 kpc, comparable to the spacing on the regular strings of H II regions observed in many external spirals.

Although the complexes interior to the Sagittarius Arm do not reveal a very clear spiral pattern, this appears to be largely due to the fact that these complexes mainly cluster on the near side of the

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Galaxy. This apparent asymmetry may be partially due to the fact that distant clouds are more difficult to detect, but the clarity of the Sagittarius Arm out to a distance of 14 kpc suggests that this is not the complete explanation. It is worth noting that, if such an asymmetry exists in the so-called "molecular ring" region, then the total CO luminosity and subsequently molecular mass of the region has been overestimated by the axisymmetric models used to analyze CO-survey data (e.g., Cohen and Thaddeus 1977, Burton and Gordon 1978).

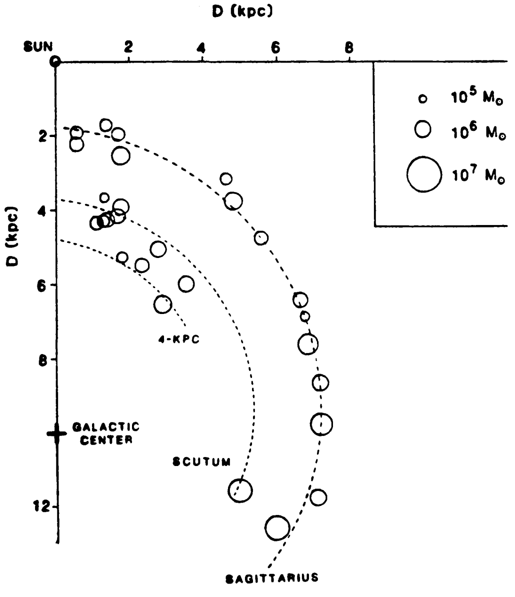

Figure 1. The locations in the galactic plane of the molecular complexes we have identified with masses > 10^5 $M_\odot$. The dashed lines are logarithmic spirals: the Sagittarius spiral is a least-squares fit with a pitch angle of 5°.3; the Scutum and 4-kpc spirals are not fitted, but are taken from the 21-cm analysis of Shane (1972).

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