A CO(2-1) SURVEY OF THE SOUTHERN MILKY WAY

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We have used the Estec/Utrecht heterodyne submillimetre receiver together with the 1.4 m ESO CAT at La Silla (Chile) to survey the southern Galaxy (l = 270 - 355°) in the CO(2-1) transition at 230 GHz (1.3 mm). The beam used had a HPBW size of 5.5 arcmin, overall system efficiency was 0.35, and the system temperature was 1400 - 1750 K (DSB). Our filterbanks had velocity resolutions of 1.3 and 0.325 km s^{-1} and velocity ranges of 333 and 83 km s^{-1} respectively.

The survey consists of three parts: 1. a survey of the galactic plane (b = 0°) in the range l = 270 - 355°; 2. a survey of 88 dark clouds with and without associated nebulosity; 3. a survey of 47 bright HII-region complexes. Some additional observations were made with the same receiver and the use of the ESO 3.6 m telescope (beamsize 2 arcmin HPBW). The following is a summary of the results obtained; they are published in more detail elsewhere (Israel et al, 1983; De Vries et al. 1983; Brand et al, 1983).

We obtained contour maps of CO(2-1) emission in the galactic plane, with an effective velocity resolution of 5.2 km s^{-1} and convolved to spatial resolutions of one and two degrees (see Israel et al. 1983). The CO distribution is very clumpy, and shows numerous holes. There is a lack of emission shortwards of l = 300°, due to the tilt of the Galaxy which places most material here below b = 0°; the CO complex associated with the Carina Nebula is just visible. In general, the CO(2-1) distribution is very similar to that observed in the CO(1-0) transition (c.f. McCutcheon et al., this volume). In addition, we find that in the south the 'molecular ring' is broader than in the north and also shows a double-peaked structure; that the cloud-cloud velocity

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dispersion is 4.5 ± 0.5 km s^{-1} as it is in the northern hemisphere, and that the CO(2-1) terminal velocities closely follow the Sinha (1978) rotation curve.

We detected over 50 per cent of all dark clouds observed; these statistics are strongly influenced by beam-dilution effects (i.e. clouds not detected were usually significantly smaller than the beam). Dark clouds associated with nebulosity have measured velocity widths between 1 and 5 km s^{-1} with a mean around 2.8 km s^{-1}. This indicates that the majority of these clouds shows the influence of interaction between dark-cloud material and associated stellar energy sources. Particularly clear examples of such interaction are found in the dark clouds associated with Herbig-Haro objects HH 46/47, HH 52/54 and GGD 27/28. In contrast, dark clouds not associated with nebulosity with very few exceptions show velocity widths between 1 and 2 km s^{-1}. Consequently, the majority of these clouds does not contain a hidden stellar energy source. A good example is given by the Coalsack globules (Tapia, 1973).

About a quarter of all dark clouds observed with sufficient signal-to-noise shows enhanced wing emission (and/or asymmetrical profiles), red wing emission being more common than blue by a factor of three. The number of clouds with enhanced wing emission is a lower limit because of the limited sensitivity of our observations. Thus mass outflow seems to be a very common phenomenon in relatively cool dark clouds, as it is on a more energetic scale in hot dark clouds associated with HII regions (c.f. Bally and Lada, 1983).

Out of 47 HII regions observed (mainly RCW sources) we detected 28. The results are generally consistent with those obtained earlier in the CO(1-0) and CO(2-1) transitions by other workers. Three objects were observed in more detail (RCW 36, G327.3-0.6/RCW 97 and W 48). Of these, RCW 97 turned out to be the most interesting. It shows a compact CO cloud core in which two active star-formation sites are embedded. The two sites are consistent with sequential star-formation models; the youngest of the two shows characteristics of strong bipolar mass outflow.

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