HI AT THE OUTER EDGE OF THE GALAXY AND ITS IMPLICATIONS FOR GALACTIC ROTATION

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In their analysis of global properties of the Galaxy based on the HI distribution outside of the solar circle, Knapp, Tremaine, and Gunn (1978 - hereafter referred to as KTG) have examined the extreme HI velocities for the outer edge of the Galaxy. They fit these values to a model based on an exponential drop-off of HI surface density with galactocentric radius, R, and a flat rotation curve. Adopting a value of 4 kpc for the scale length, L, of this drop-off, KTG fit the extreme velocities with various values of Θ_o (the circular rotation speed of the Local Standard of Rest), to obtain a best fit of Θ_o = 220 km/s. While KTG obtained sensitive observations with the NRAO 43-m radio telescope for the galactic-longitude range l = 80° to 225°, they had to rely on the HI survey by Kerr, Harten, and Ball (1976 - hereafter referred to as KHB), obtained with the Australian 64-m radio telescope at Parkes, for the balance of the Southern Milky Way.

A fully-sampled HI survey, using the Parkes 18-m telescope and extending to galactic latitudes ±10°, is now ready for publication (Kerr et al. 1983). The values for the extreme HI velocities for the outer Galaxy have been determined as a function of l and were found to be systematically higher than one would determine using KHB. The reason for this discrepancy is apparently that KHB used a filter-bank receiver with limited velocity range and, consequently, the upper velocity of their observing window was at a velocity where HI emission is still present. The 18-m survey, while also using a filter-bank receiver, used a wider bandpass which has definitely included all of the HI.

The extreme velocity at which HI appears at a brightness temperature >1 K has been determined for all galactic longitudes using both the 18-m survey and the Weaver and Williams (1973) HI survey. Latitudes up to |b| = 10° were searched. Results are plotted in Figure 1 along with the predictions of KTG for their model with Θ_o = 220 km/s and 250 km/s. As reported elsewhere (Jackson and Kerr 1981), the southern Milky Way data fit with Θ_o = 250 km/s while the northern Milky Way data fit with Θ_o = 220 km/s. Figure 1 may be compared directly with Figure 12 of KTG.

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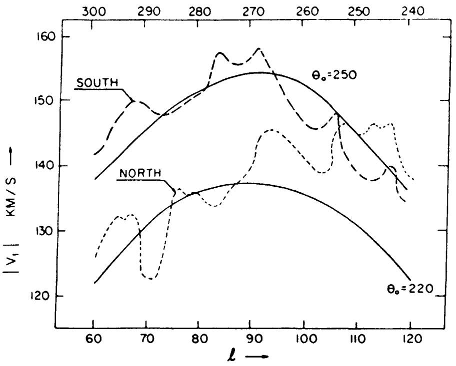

Figure 1. The largest velocity at which the HI brightness temperature exceeds 1 K plotted against l for the northern and southern Milky Way.

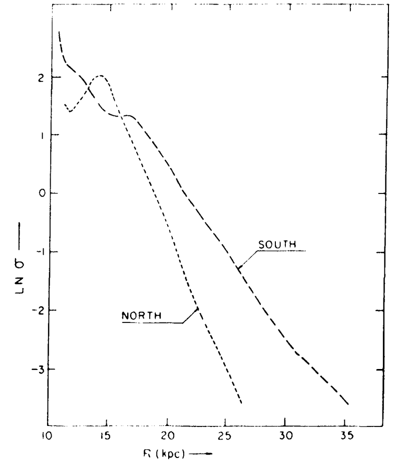

Figure 2. The neutral-hydrogen surface density in solar masses per square parsec plotted against galactocentric radius in kilo-parsecs.

More recently, an analysis (Henderson, Jackson, and Kerr 1982) of the 18-m and Weaver and Williams surveys has yielded a determination of the surface density, σ, of the HI as a function of R assuming a flat rotation curve, and is plotted in Figure 2 on a logarithmic scale. Straight-line fits yield L = 2.2 for the northern and L = 3.3 kpc for the southern Milky Way. Clearly, a steeper drop-off in the southern HI surface density than that used by KTG, assuming other model parameters are unchanged, means that they have underestimated Θ_o. In fact, KTG find that Θ_o = 250 km/s can fit their data if L = 3.2 kpc. New models should now be run with the steeper density gradient and, perhaps, also with a rising rotation curve in view of the results of Blitz, Fich and Stark (1980) and Chini (1983).

REFERENCES

Blitz, L., Fich, M., Stark, A.A.: 1980, in "Interstellar Molecules", IAU Symp. 87, ed. B.H. Andrew (Reidel, Dordrecht), p. 213

Chini, R.: 1983, IAU Symp. 106, "The Milky Way Galaxy"

Henderson, A.P., Jackson, P.D., Kerr, F.J.: 1982, Astrophys. J. 263, 116

Jackson, P.D. and Kerr, F.J.: 1981, Bull. Amer. Astron. Soc. 13, 538

Kerr, F.J., Bowers, P.F., Kerr, M., Jackson, P.D.: 1983 (in preparation)

Kerr, F.J., Harten, R.H., Ball, D.L.: 1976, Astron. Astrophys. Suppl. Ser. 25, 391

Knapp, G.R., Tremaine, S.D., and Gunn, J.E.: 1978, Astron. J. 83, 1585

Weaver, H. and Williams, D.R.W.: 1973, Astron. Astrophys. Suppl. Ser. 8, 1