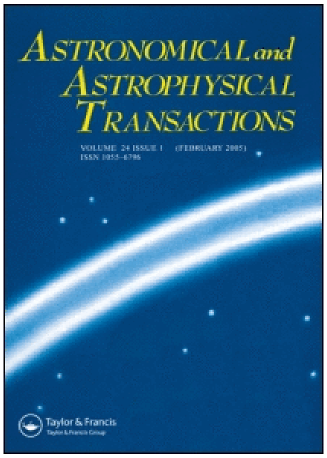

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KINEMATICS OF NEUTRAL HYDROGEN FROM THE 21 cm LINE OBSERVATIONS†

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The dependence of the rotation curve of the neutral hydrogen on z was found taking into account the general warping of the HI layer.

KEY WORDS Galaxy – structure and kinematics: rotation curve

Neutral hydrogen 21 cm line observations can be used for the study of the global kinematics of the Galaxy. A method which utilizes the whole 21 cm line profile and provides the possibility of determining the rotation curve in outer regions of the Galaxy and, furthermore, the dependence of the rotation curve on the z-coordinate has been suggested by Agekyan *et al.* (1965). That kind of investigation has been made with the assumption of a symmetric distribution of the HI density about the galactic plane. But it is well known that the HI layer is warped above the galactic plane in the north and below the plane in the south beyond the solar circle. In the outer region of the galactic plane the rotation curve was corrected for the warp of the hydrogen layer by Gerasimov and Petrovskaya (1990). The aim of this work is to obtain the z-gradient of the rotation velocity corrected for the bending of the HI layer.

Let us assume that the HI density is determined by expression (1) on the surface of maximum hydrogen density $z = f(x, \psi)$ (where ψ is the galactocentrical azimuthal angle in the plane $z = 0$)

$$N(x_1, z_1) = N(x, z)(1 + A\Delta x + B\Delta z)\,, \tag{1}$$

where the functions $x_1 - x = \Delta x(x, z, l, b)$ and $z_1 - z = \Delta z(x, z, l, b)$ are defined by the form of the HI bending ($x = R/R_0$ and z is measured in units of R_0). The form of the surface $f(x, \psi)$ was found from the data of Henderson *et al.* (1982). The functions Δx and Δz are expressed by

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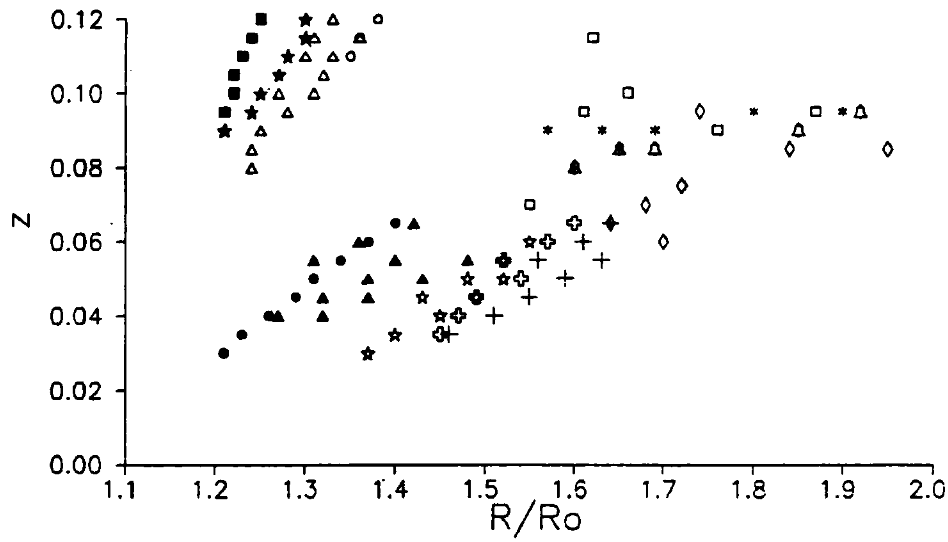

Figure 1 The value $\Omega(x,z) = -20$ km/s (•); -30 (△); -40 ( ); -50 ( ); -60 (+); -70 (◇); -90 (□); -100 (∗); -110 ( ); -130 (∘); -140 (△); -150 (⋆); -160 (□).

$$\Delta x(x,z,\psi) = [z - f(x,\psi)]\tan\Phi(x,\psi) + \frac{1}{2}\int_a^x \tan^2\Phi(x,\psi)\,dx,$$

$$\Delta z(x,z,\psi) = -f(x,\psi) + \frac{1}{2}[z - f(x,\psi)]\tan^2\Phi(x,\psi), \tag{2}$$

where $\tan\Phi(x,\psi) = \partial f(x,\psi)/\partial x$; $|\partial f(x,\psi)/\partial x| \ll 1$ and Φ is the galactocentric altitude. The values of A and B in expression (1) have been determined from the earlier investigation of the dependence $\Omega(x,z)$ by Bektasova and Petrovskaya (1990) as well as the values Ω'_x and $\Omega'_{|z|}$. It is important that the inequality $\Omega'_{|z|} \ll \Omega'_x$ is true. Hence, the optical depth at the frequency corresponding to the radial velocity V_r at the galactic longitude l and latitude b can be presented as

$$\tau(V_r,l,b) = \frac{y[(1 + A\Delta x + B\Delta z)\sqrt{1 - x^{-2}\sin^2 l} - (\Omega'_{|z|}/\Omega'_x)|\tan b|]}{|\sin l|\cos^2 b(1 - x^{-2}\sin^2 l)}\,. \tag{3}$$

The unknown parameter is $y = kN(x,z)/|\Omega'_x|$. Let us suppose the Gaussian distribution for the observed depth $\tau_i = \tau(\Omega, l_i, b_i)$; we can use the maximum likelyhood method to find $\Omega(x,z)$.

The observational data of Weaver and Williams (1974) were used for the northern part of the Galaxy ($20° < l < 180°, -30° < b < +30°$). The results of the calculation are presented in Figure 1. As seen in Figure 1, $\Omega(x,z)$ decreases with

x from $\Omega = -20$ km/s up to $\Omega = -60$ km/s in the range $z < 0.060$. However, at greater z the surface of equal circular velocities $\Omega(x, z)$ =const have been in the reverse order, but the dominating effect of increasing $\Omega(x, z)$ with z is clearly seen. A possible explanation of this interesting effect is a global events of the gas streamers that could be moving in the galactic plane away from the center and in the opposite direction further from the galactic plane. The gradient of $\Omega(x, z)$ has been estimated as -25 km/s per 100 pc, that is the earlier value.

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References

Agekyan, T. A., Petrovskaya, I. V., and Fesenko, B. I. (1964) *Astron. Zh.* **41**, 1027.
Bektasova, N. K. and Petrovskaya, I. V. (1990) *Trudy Astrofiz. inst.* **41**, 23.
Gerasimov, A. G. and Petrovskaya, I. V. (1990) *Kinematika i Fiz. Nebesn. Tel.* **6**, No. 3, 419.
Henderson, A. P., Jackson, P. D., and Kerr, F. J. (1982) *Astrophys. J.* **263**, 116.
Weaver, H. and Williams, D. R. W. (1974) *Astron. Astrophys. Suppl.* **17**, 1.

DISCUSSION

Kutuzov: Are the values of the gradient the same towards the Northern Pole and to the Southern one?
Bektasova: Yes.
Petrovskaya: For which quadrants is the work done?
Bektasova: This work was done for the I and II quadrants and the observational data of Weaver and Williams (1974) were used.