YOUNG GALACTIC CLUSTERS AND THE ROTATION CURVE OF OUR GALAXY

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The most recent determination of Oort's galactic rotation constant 'A' from open clusters was made by Taff and Littleton (1972). They obtained A=15 km/s/kpc, but unfortunately they omitted a detailed description of their cluster sample. For the present work we compiled a catalogue of O-B3 clusters for which radial velocities and distances are available. The individual cluster references given by Janes and Adler (1982) have been used to find best distances for the clusters. Radial velocities were taken from the list of Dr. Wramdemark (private communication) and from Hron et al. (1984). The catalogue contains 105 clusters distributed over the four galactic quadrants as 16:27:35:27.

Assuming circular motions in our Galaxy, the relation between the difference of the angular velocities w(R) and $w(R_o)$ at the galactocentric radii R and R_o (=at the Sun) and the observed radial velocity corrected to the Local Standard of Rest V_r(LSR) is:

$$w(R)-w(R_o) = V_r(LSR)/(R_o \sin l \cos b).$$

'A' was computed from a weighted least-squares fit:

$$w(R)-w(R_o) = \text{const} - 2(A/R_o)(R-R_o) - 2(\alpha/R_o)(R-R_o)^2$$

The weighting factor $\sin^2 l$ assigns low weight to clusters at longitudes where small deviations from circular motion or observational errors in V_r have large influence on $w(R)-w(R_o)$.

The results for 'A' depend sensibly on the interval of $R-R_o$ chosen for the fit:

The whole sample yields $A = 16.9 \pm 1.3$ and a statistically significant curvature term $\alpha = -2.1 \pm 0.8$. However, if we consider only clusters with $R-R_o > -1.5$ kpc and exclude those with lowest quality of V_r and distance, α becomes statistically insignificant and 'A' drops down to about 13 km/s/kpc.

H. van Woerden et al. (eds.), The Milky Way Galaxy, 105–106.

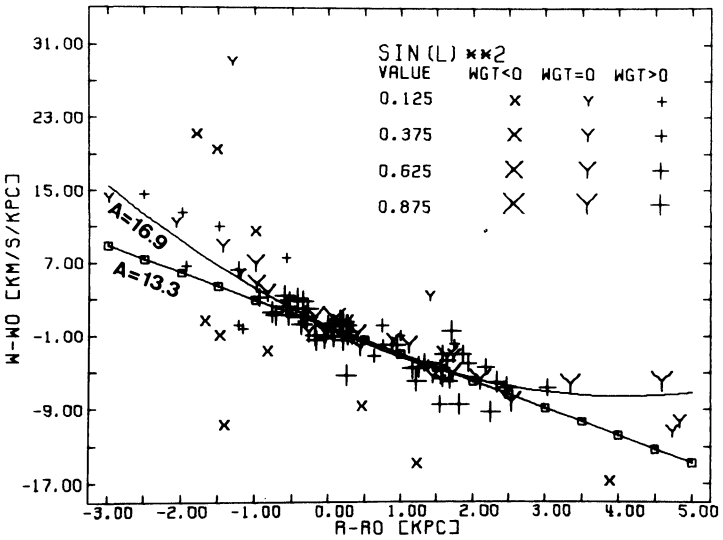

Fig. 1. The galactic rotation curve $w(R)-w(R_o)$ from young open clusters (R_o = 9 kpc and Standard Solar Motion adopted). Symbol size is proportional to $\sin^2 \ell$ as indicated. The symbols denote 3 classes of clusters:
'Y' - clusters of lowest quality in V_r and distance.
'X' - clusters deviating more than 3 s.d. in the preliminary fit and excluded from the final fit.
'+' - clusters used in the final fit.
The two lines represent the cases described in the text.

Fig. 1 illustrates this situation: points left of $R-R_o$ = - 1 kpc exhibit a marked increase of scatter, which is largely due to the low sin l values associated. Nevertheless, due to the relatively high values of $w(R)-w(R_o)$ in this region, the curvature term must obviously become significant.

Whereas A = 13.3 $\pm$ 1.5 derived for $-1.5 < R-R_o < 2.5$ kpc can be regarded as good local value of 'A', a more global definition of this galactic rotation constant (taking into account the curvature of $w(R)-w(R_o)$) should be based on an enlarged sample of clusters with larger $|R-R_o|$ and better quality than currently available for them.

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