

# INTERPRETATION OF THE APPARENT ANOMALIES OF THE GALACTIC STRUCTURE

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In maps of the galactic structure based on the kinematical method (Fig. 1) several systematically heliocentric anomalies are found:

1. Assuming purely circular motion, the spiral arms are more tightly wound and the extent of neutral hydrogen is smaller in the northern galactic hemisphere than in the southern one.
2. With separate rotation curves for the north and the south, the arms become anomalously circular.
3. Consequently, there is a striking discrepancy with the stellar spiral structure.
4. There are long straight portions in the arms pointing towards the Sun.
5. There are abrupt knee-like features in the south.
6. Some arms seem to affect the structure of other, outer arms.
7. Conspicuously strong curvature of the arms is found in the north.
8. The HI-density is enhanced at symmetric longitudes on the far side.
9. With the northern rotation model HII-regions and HI avoid the southern tangential circle.
10. The Perseus Arm is displaced at  $l = 180^\circ$ .

These features are not random or small-scale fluctuations, nor can they be explained by a general expansion of the Galaxy or by a local outward motion. The systematic and heliocentric character of the anomalies indicates the presence of a non-Dopplerian, distance-dependent effect superposed on the kinematical line-shift data. A simple model involving a non-velocity redshift field within the Galaxy, enhanced within the spiral arms, is presented. The effect increases the positive velocity shifts and reduces the negative ones, with corresponding distortions in kinematically produced spatial maps.

Using this model and assuming that the spiral arms are not actually distorted, numerical simulation of the apparent spatial structure of the Galaxy reproduces all the anomalous features listed above (Fig. 2). The enhanced effect within the spiral arms causes the features 4, 5, and 6, and strengthens the other features. The continuous disk lineshift effect explains features 1 and 7-10. The reason for features 2 and 3, which have presented a major unsolved problem of galactic research, is an erroneous linking of a northern arm with an inner southern arm, as provoked at  $l = 0^\circ$  by the distortion effect in the kinematical maps.

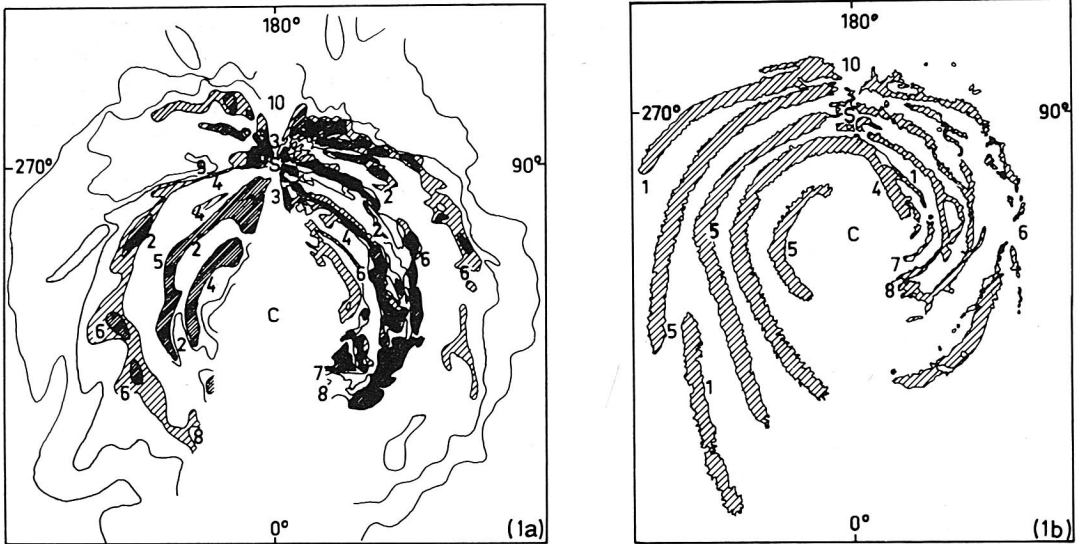


Figure 1. Schematic maps of the galactic neutral hydrogen redrawn from previously published maps. (a) From the classic map (Kerr and Westerhout, 1965) based on separate rotation models for the north and the south, (b) The map based on the northern rotation curve (from Weaver, 1975). Anomalous features discussed are indicated.

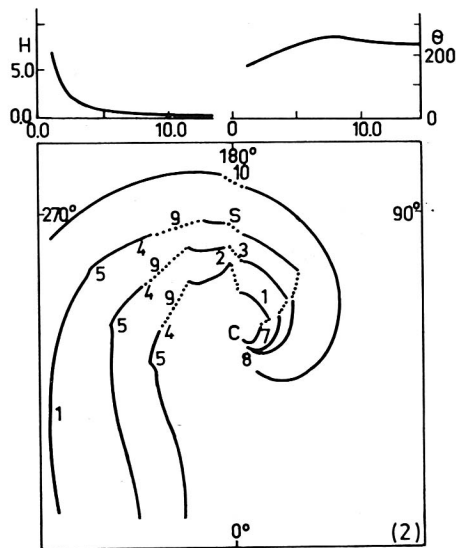


Figure 2. Numerical simulation of anomalies. The rotation model is shown in the upper right corner, the strength of the disk redshift (in  $\text{km}/(\text{s kpc})$ ) in the upper left corner; the additional redshift within the spiral arms is  $4 \text{ km}/(\text{s kpc})$ ; the original undistorted arms are logarithmic spirals. Compare this figure with Fig. 1b.

The successful solution of ten very diverse structural anomalies demonstrates the existence of the non-velocity effect. Independent evidence is given by the data on a systematic redshift of the galactic nucleus (Jaakkola, 1978); by the data on the longitude-independent latitude-redshift relation (Moles and Jaakkola, 1977); and by the data on positive line-shift gradients across the disks of external galaxies (Jaakkola *et al.*, 1975). The strength of the effect within the Galaxy and in external galaxies is an order of magnitude higher than that of the cosmological redshift effect. Future observations of redshift gradients across the disks of galaxies will provide a definitive test of the present hypothesis.

By removing the non-velocity effect from the data it is quite possible to obtain a consistent, bilaterally and cylindrically symmetric picture of both the structure and the kinematics of the Galaxy.

#### REFERENCES

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Jaakkola, T., Teerikorpi, P., and Donner, K.J.: 1975, *Astron. Astrophys.* 40, 257.  
Kerr, F.J., and Westerhout, G.: 1965, in "Galactic Structure", A. Blaauw and M. Schmidt, eds., Chicago Univ. Press, p. 167  
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Weaver, H.: 1975, *Mercury* 4, No. 6, 18.

#### DISCUSSION

**F.J. Kerr:** Are you suggesting any particular physical cause for your non-velocity lineshift?

**Jaakkola:** The cause is the same as for the cosmological redshift. Of course, if there is such an enhanced redshift field within the Milky Way, this indicates that the redshift is an interaction phenomenon, not a Dopplerian phenomenon.



Top: T.S. Jaakkola fills his glass, while Ria van Woerden considers her choice of wines at University President's reception. To her left: J.W. Pel. CFD  
Bottom: Allen explains his views on star formation to Elmegreen. CFD

