ON THE DISTRIBUTION OF ANGULAR VELOCITY IN THE SUN

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Abstract. The angular velocity distribution as a function of heliographic latitude is directly observed at the solar surface. Also the dependence of the angular velocity on the distance from the solar centre can be studied observationally for the outermost layers of the Sun. But within the Sun the study of angular velocity depends very much on assumptions. One possibility to study the problem is given by the fact that in a bipolar magnetic group the leader is compact while the follower is dispersed over a large area. In Leighton's theory, following Babcock, this phenomenon is explained, in principle, in the following way: Slide 1. When a magnetic rope, as a result of magnetic buoyancy, rises to the surface, it is twisted by differential rotation. Dashed lines in the figure represent *isotachial* surfaces. When the rope has risen to the surface, the two ends are twisted in opposite directions. The surface differential rotation continues to twist one of the now free ends of the rope, while it untwists the other free end. Both twisting and untwisting are, in fact, very slow. They are fastest at the latitude of 35°, where the magnetic rope is rotated once in 26 days. We understand that the distribution of angular velocity within the Sun is involved in this picture. The twisting in the interior can be written equal to the untwisting of the follower spot produced by the surface differential rotation. Of course there are many solutions. Slide 2 gives two of them. The lines represent calculated *isotachial* surfaces and the numbers give the observed angular velocities in radians per day. In the left-hand side distribution the velocity decreases inwards, while in the right-hand side distribution it increases inwards. The right-hand side distribution is also consistent with the conclusion derived from observations that the tilt of sunspot axes from the vertical is relatively small, and with the observation that at the equatorial plane, near the surface, the rotational velocity does not vary with depth.

Reference

Tuominen, I. V. and Tuominen, J.: 1968, *Astrophys. Letters* **1**, 95.

DISCUSSION

Kasinskij: I would like to comment on Dr Tuominen's report by presenting some evidence about angular velocity changes in the chromosphere. The considerations are based on the vector-shifting butterfly diagrams which I have constructed for the mean flare positions relative to sunspots. This vector-diagram disclosed that at the beginning of a cycle there are strong 'east' and at the end of the cycle visible 'west' displacements. Thus, by interpreting this phenomenon in terms of angular velocity changes one can say that the southern hemisphere rotates more slowly at the beginning and faster at the end of a cycle than the northern hemisphere.

Some synchronized form of rotation takes place near the maximum. Therefore one can conclude that in the chromosphere there exists some kind of torsion oscillation which may be predicted by some theories.

Bumba and Kleczek (eds.), Basic Mechanisms of Solar Activity, 415. *All Rights Reserved.*
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