# ORIENTATIONS OF NEW SUNSPOT GROUPS

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ABSTRACT We have studied the tilts between the direction of the rotation and the magnetic axes of the emerging active regions in the year 1977. We have examined the distribution of orientations in comparison with possible subsurface velocity fields by seeking recognizable patterns of distribution.

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The data of the Debrecen Photoheliograph Results 1977 were used, (Dezső et al.1987). We considered only those sunspot groups, for which the catalog recorded both the appearance and the formation of the bipolar character within three days except the groups belonging to the previous cycle, this means 76 sunspot groups in 1977. Let the tilt be positive if the preceding part is nearer to the equator than the following one, on either hemispheres. We characterize the tilts by appropriate weights: if the sunspot group has an angle $\alpha_i$ and area $A_i$=U+P on the i-th day of its existence, then let its weight:

$$W=(\Sigma\alpha_i(A_i)^{.5})/10 \quad (i=1,2,3).$$

52 cases are positive and 24 negative in the given material. It is impossible to recognize any pattern in the distribution of the angles in the Carrington coordinate system, therefore we assumed that the angular distribution is related to a certain subsurface formation of unknown angular velocity. So far the only published internal longitudinal structural pattern is the so-called "banana-roll" system (Glatzmaier,1984, Gilman,Miller, 1986) which takes the shape of a banch of bananas, so that the material ascends (expands) in the border of two given "bananas" and it descends (contracts) in the consecutive border, resulting positive or negative Coriolis-turns respectively.

We took hypothetical internal sector structures with given wavenumbers (l). If the position of a sunspot group of positive (negative) weight coincided with a positive (negative) sector (allowing a ±2°.5 overlap between two sectors), then the absolute value of its weight was added to a sum of weights (ΣW), if not, then it was dropped, so this sum of weights characterizes the coincidence of the given sunspot group tilts with the supposed sector structure. We changed the Δω differences between the internal and Carrington rotation rate in the range of $-3.2<=\Delta\omega<=4.1$ (deg/day) by 0.01 (deg/day) steps. The position of the sector structure in the Carrington system was shifted through the range of two sectors (one wave) by 2° steps in order to find the best coincidence. The possible curvatures of the sectors were computed by the formula: $Z*4*\sin^2 B$, where the Z changed from 0 to 36 by steps of 2. For the wavenumber l=11 the largest values of ΣW have been chosen for all Δω values and they are plotted in the Figure 1. above ΣW=1207 (this is the average of ΣW plus its stand.dev.)

The most remarkable feature of the Figure 1. is the band of high maxima around Δω=-0.35 deg/day, the other maxima are of much less importance and they are probably spurious peaks. All maxima of the main band are characterized by small curvatures of sectors. The same procedure was carried out also with wavenumbers l=9-15, but they gave no similar remarkable peaks.

The above findings are consistent with a practically not bended north-south roll system having the longitudinal wavenumber l=11 (there are theoretical and also observational hints for this l see. e.g. by Glatzmaier,1985, Gilman,Miller,1986). This system would rotate slower than the Carrington rate by Δω=0.35 (deg/day) in accordance with the results of Abuzeid and Petrovay,1990.

Further details of this study will be published elsewhere.

REFERENCES

Abuzeid B., Petrovay K.(1990) this proceedings.
Dezső L., Kovács Á., Gerlei O.(1987): Debrecen Photoheliographic Results 1977, Publ.Debrecen Obs. Heliogr.Ser.No.1.
Gilman P.A.,Miller J.(1986): Ap.J.Suppl., Vol.**61**., pp.585-608.
Glatzmaier G.(1984): J.Comp.Phys.,Vol.**55**., p.461.
Glatzmaier G.(1985): Ap.J., Vol.**291**., pp.300-307.

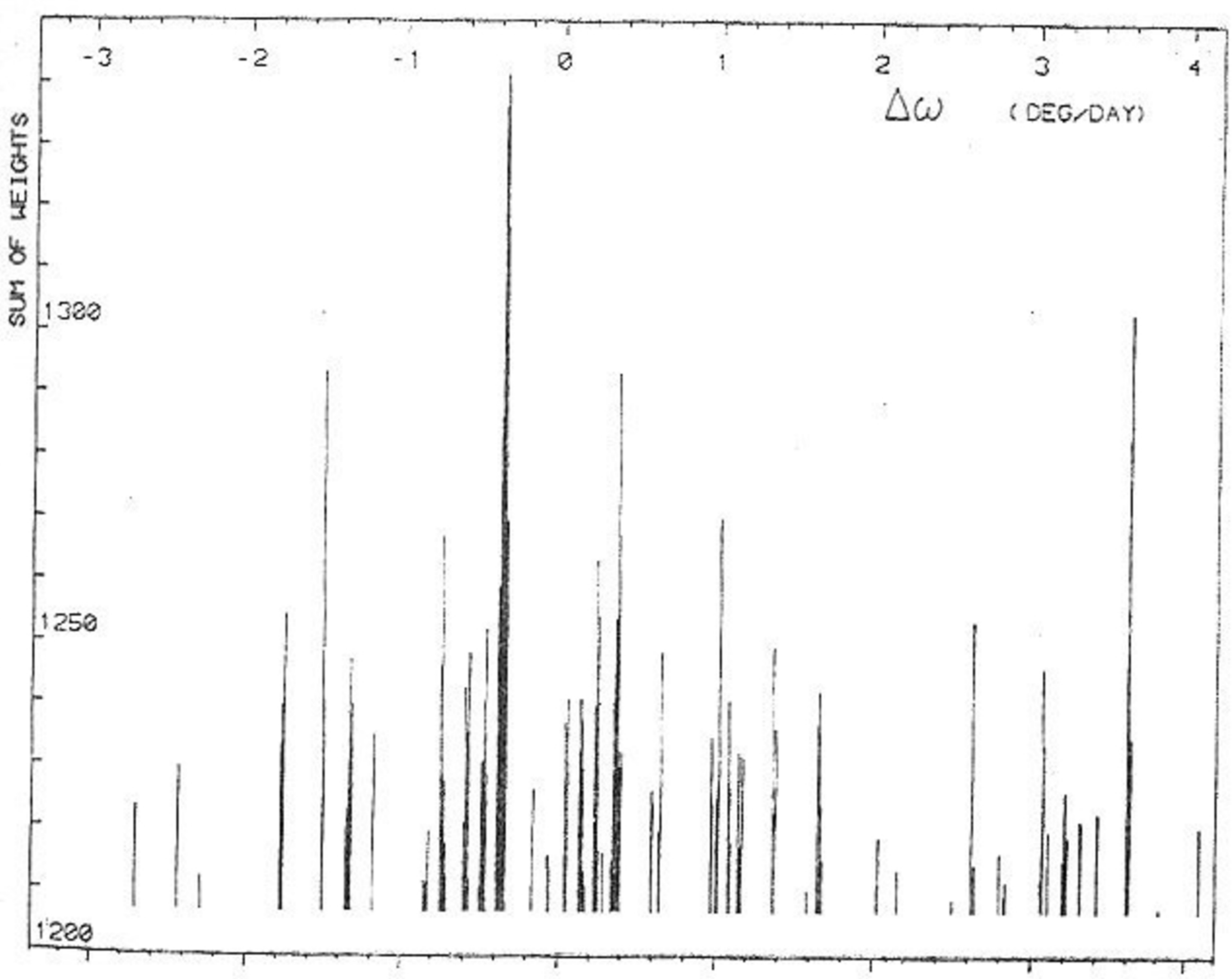


Figure 1. Sums of weights characterizing the coincidence of sunspot group orientations with the corresponding sectors of a supposed north-south roll system of longitudinal wavenumber l=11 as a function of Δω (difference of the internal and Carrington rotation rate)