Publ. Obs. Astron. Belgrade No. 49 (1995), 121-125

SUNSPOT'S PROPER MOTIONS IN TWO NEARBY ACTIVE REGIONS

G. CSEPURA, L. GYŐRI and O. GERLEI
Heliophysical Observatory of the Hungarian Acad. Sci. H-4010 Debrecen Po. Box. 30. Hungary
E-mail csepura@tigris.klte.hu

Abstract. Using white-light heliograms, the proper motions of two adjacent sunspot groups were studied. A conspicuous similarity between the proper motions of the leader spots of the two active regions has been found. At first, they showed vigorous westward motion after that they stopped on the same day when a new activity in the sunspot groups has set in. This result is in good agreement with the finding of an investigation made earlier in another two active regions (Csepura 1990).

1. INTRODUCTION

The connection between sunspot groups developed nearby has been studied by a numbers of people. It has been pointed out that nearby sunspot groups can show signature of interaction in their proper motion and area development (Matres 1970, Sheeley 1981). In former studies (Csepura et al 1990, L. van Driel-Gesztelyi 1992), it has been experienced that, in two adjacent activity regions, the sunspots moved almost parallel and changed the direction of their motion on the same day at almost the same heliographic longitude. Observation of the simultaneous appearance of new activity in both groups was also reported in these studies. G. Poletto, G. A. Gray and M. E. Machado (1993) claim : "What we image in X-rays is not a long loop (the "bridge") along which some disturbance propagates, but an arcade of shorter loops connecting AR 2522 and AR 2530 -which participates in the general re-arrangement of the field and thus act as a "channel" along which the destabilization progresses and eventually leads, in places where the stored energy is highest - as also revealed by magnetic shear observed in MSFC magnetograms - to the occurrence of a flare".

2. OBSERVATIONS

At the Heliophysical Observatory of the Hungarian Academy of Science in Debrecen and its Gyula Observing Station 226 white-light, full-disk photoheliograms were taken between 21-28 June 1980, which we used for a study of the proper motion and the evolution of Hale regions 16923 and 16931. The method of observation and the computation of the heliographic coordinates is described in the Introduction to the Debrecen Photoheliographic results by Dezso et al. (1988).

3. DEVELOPMENT OF THE ACTIVE REGIONS

In this investigation Hale region 16923 (AR 2522) and Hale region 16931 (AR 2530) were studied. HR 16923 rotated onto the disk on 16 June 1980 as a return of HR 16824. In HR 16931, a sunspot group began to develop on 21 June 1980. These two adjacent region were target of observation for coordinated Flare Buildup Study from 24-30 June 1980 (Fig.1). The overall structure of both sunspot groups were bipolar. The two sunspot groups were within DL=7 and DB=5 degree (Fig.2). The main motions in both regions were those characterizing the bipolar regions : spots in the preceding part of the group moved westward and spots in the following part moved eastward (Fig.2). The dipole axis of HR 16931 was inclined slightly relative to parallels of latitude, with the leading polarity nearer to the equator, that is normal, but the one of HR 16931 was inclined slightly in the opposite direction i.e. with the leading polarity further from the equator. The development of both regions were very fast so that changes in magnetic complexity had time scales¡ 24h (Schmahl 1983). A parasitic polarity (N10), causing increased flare activity in its vicinity, emerged in the preceding polarity region (S3) of HR 16923 near its midpoint on the 23rd (Fig.1).

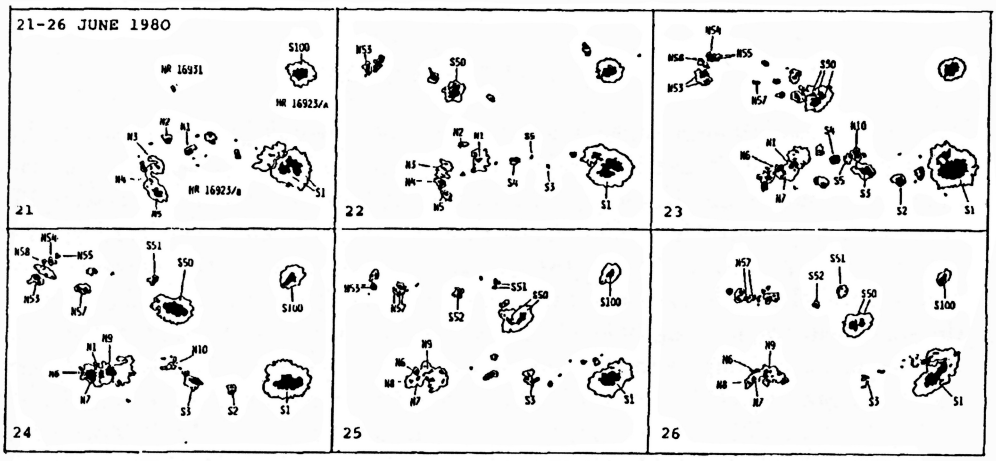

Fig. 1. Development of the sunspot groups in Hale regions 16923/A, 16923/B and 16931 between 21-26 June 1980. The denotations of umbrae show their magnetic polarity : N and S means north and south polarity.

4. PROPER MOTIONS

The most striking common characteristic of the proper motions of the two sunspot groups is the suddenly stop of the vigorous westward motions of their leader spots at 26th and, after it, the change of the direction of this motion at 27th as it can be fairly seen in (Fig.2). This is in full agreement with the result (Csepura 1990) found at the study of another two adjacent active regions (Mt. W. 21517, Mt. W. 21526) that the leader spots of these groups turned simultaneously as its depicted in Fig. 4.

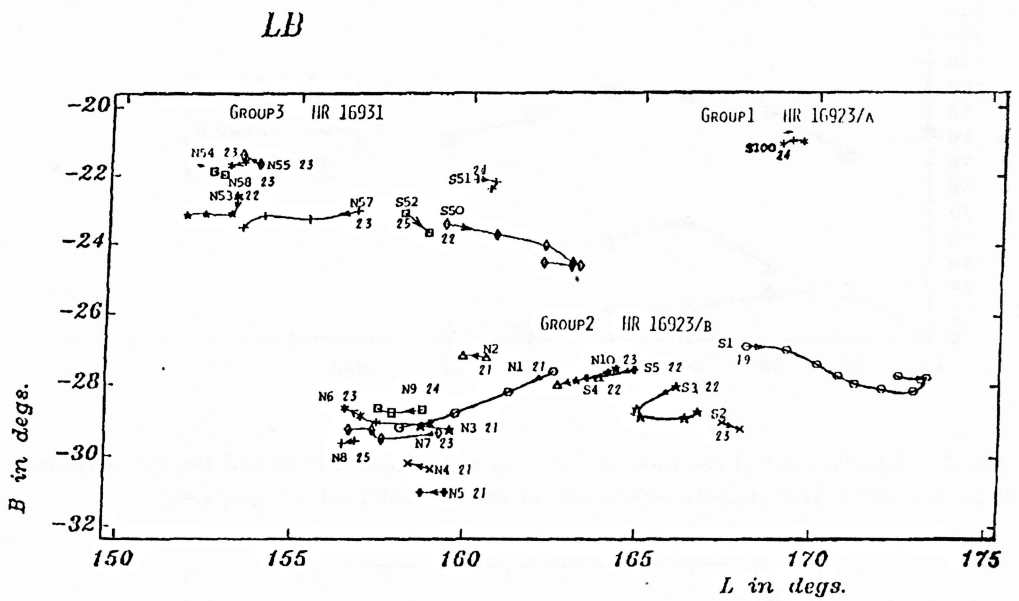

Fig. 2. Proper motions of umbrae in Group1, Group2 and Group3 between 19-28 June 1980. The preceding umbrae are marked with the letter S and the following umbrae with the letter N, referring their magnetic polarity. Italics numbers indicate beginning days.

This sudden change of the motion of the leader spots can be connected to the new activity of HR 16923 which begin to developed in and around its leader spot from 27 June onwards. It was shown by Simnett et al. (1984) and confirmed by Kundu et al. (1984) and by Kundu, Cheng and Schmahl (1990) that, at the time of major flares, extensive magnetic structures linked the two regions in HXIS and in VLA at 6 cm, respectively. Now, on the basis of our investigations, a supposition on a connection below the photosphere, of the two regions, causing the similar proper motion of the leader spots, could emerge. Or, as an another possibility, it could be attributed to the existence of large-scale flows in the vicinity of the close- by developing active regions influencing the motions of these spots. We determined the areal development of these sunspot groups, (Fig. 3). At the time of the beginning of the development of HR 16931, the umbral area of HR 16923 began to decrease and after this the two area increased together. After a few days of increasing in area, their area begin to decrease nearly at the same time (within a day shift). It is worth nothing the shared motions, associated with increased flare activity, of the different polarity spots N10 and S6 in the middle of HR 16923.

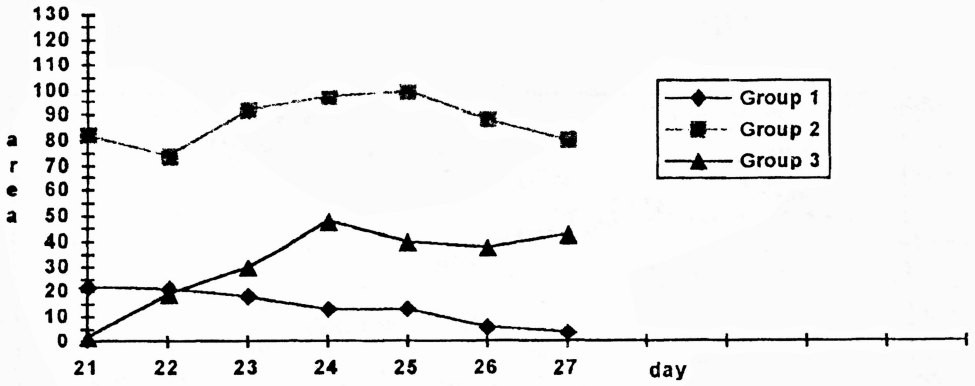

Fig. 3. Development of the total umbral area of Group1, Group2 and Group3 between 21-26 June 1980. Ac represents umbral area in units 0.000001 solar hemisphere.

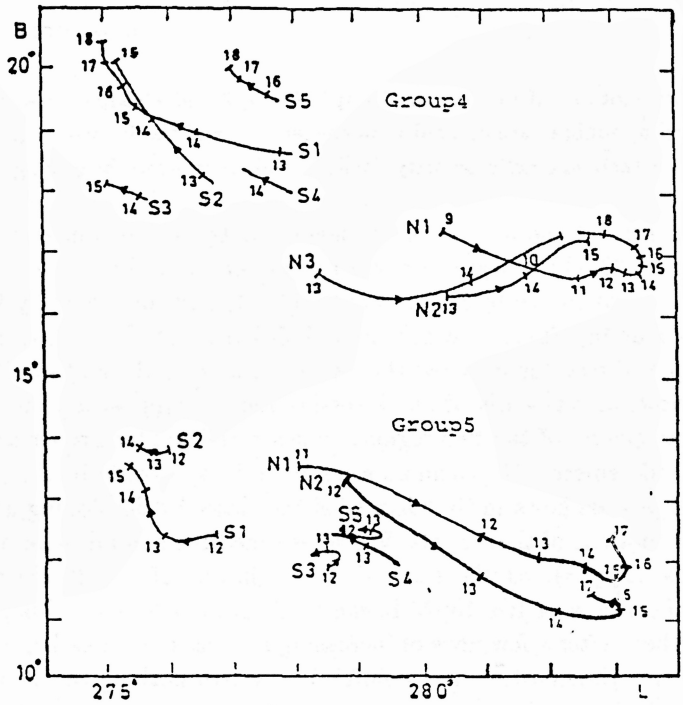

Fig. 4. Proper motions of umbrae in Group4 and Group5 between 9-20 June 1980. The preceding umbrae are marked with the letter N and the following umbrae with the letter S, showing their magnetic polarity, and also with different numbers indicate days.(EPS SOLAR MEETING 1990 Publ. Debrecen Obs. Vol. 7

Acknowledgements

This work was supported by the Hungarian Foundation for Scientific Research under grant No. : OTKA 007422.

References

Csepura, G., van Driel-Gesztelyi, L., Nagy, I., Gerlei, O., Schmieder, B., and Rayrole, L. : 1990, in *The Dynamic Sun* (Proceedings of the EPS 6th European Solar Meeting), Dezső L. ed., pp. 88.

Dezső, L. Gerlei, O. and Kovács, A. : 1988, in *Debrecen Photoheliographic Result*, Pub. Debrecen Obs. Heliographic Series No. 1. 11.

Kundu, M. R., Cheng, C. C., Schmahl, E. J. : 1990, *Solar Phys.* **129**, 343.

Kundu, M. R., Machado, M. E., Erskine, F. T., Rovira, M. G. and Schmahl, E. J. : 1984, *Astron. Astrophys.* **132**, 241.

Martres, M. J. : 1990, *Solar Phys.* **11**, 258.

Poletto, G., Gary, G. A. and Machado, M. E. : 1993, *Solar Phys.* **144**, 113.

Schmahl, E. J. : 1983, *Adv. Space Res. 2*, No. 11. 73.

Sheeley, N. R. : 1981, in *Solar Active Regions* Orral F. Q. ed., Colorado Assoc. Univ. Press, pp. 17.

Simnett, G. M., Harrison, R. A., Hoyong, P. and van Beck, H. F. : 1984, in *SCOSTEP STIP Symp. on Solar/Interplanetary Intervals* , Shea M. A. Smart D. F. and McKenna-Lawlor S. M. P. eds., Maynooth, Eire, Aug. 1982.