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THE EVOLUTIONAL CHARACTERISTICS OF MAGNETIC AND VELOCITY FIELDS OF LARGE FLARES IN AR 6659

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ABSTRACT The evolutional characteristics of magnetic and velocity fields of four large flares in AR 6659 are analysed in this paper.

1. Introduction

AR6659(N31L248) is one of the most strongest active regions in Cycle 22. The region erupted many X-ray and optical events from 1 to 17 June,1991. There were 6 largest events (SGD 1991), in which 4 were white light flares (Sakurai et al.1992). We analysed 4 flares (Table I) of the region and got some useful results.

TABLE I Flare Table (Hou and Luo 1992)

Date	Begin	Max	End	Loc	Imp	10cm	SID(D)	
6/06	0100E	0107	0206	N31E50	X12 /4B	42346	3+	WLF
6/07	0305E	0305U	0317D	N32E20	M 4.2/3B	381	2+	
6/09	0134	0138	0140D	N35E07	X10 /3B	8545	3+	WLF
6/12	0659	0711	0726	N27W29	M 2.5/2N			

2. The morphology evolution of fine structure and configuration of the magnetic fields, velocity fields

1). The morphology evolution of the sunspots in the region
The sunspot group was a longlife one.This was its 3rd passage on the disk (Hou and Luo 1992). The group first appeared from 7 to 21 April(AR6580, N29L286) and 2nd returning(AR6619, N30L269) from 2 to 16 May. On 2 June, there emerged many satellite spots with opposite polarities in the neighborhood of main spots with S polarity and this made the group area reach 2230 units, thus compact FKC structure was formed. The configuration of magnetic field of the group evolved complexly due to the emergence of large new magnetic flux (Fig.1B).
AR6659 and the super active region AR5395 (N34L257) belong to a same 'hot spots' active region (Luo 1992). Many similarities of

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morphology and magnetic field configuration exist.
2). Magnetic field configuration
Five S polarity main spots and several neighboring N polarity satellite spots concentrated in a same penumbra and formed compact magnetic island (Delta structure) which had a circular magnetic neutral line(Fig.1A,1B). Due to the emergence of large new magnetic flux, the magnetic field gradient of the two-side of the neutral lines increasing violently and made the spot group anticlockwise and formed strong shearing motion between the spots with different polarity.The spot penumbra fibers and the vector magnetic fields have basically the same trend and display evident spiral structure. This indicates that the region stores energy by virtue of the electric current increasing intensively and the potential fields are transforming to force-free field.
The line-of-sight photosphere and chromosphere magnetic fields have basically same configuration and the magnetic neutral lines are nearly in the same direction (Fig. 1A) but the chromosphere magnetic fields have opposite polarities compared with the photosphere magnetic fields at some places especially in the area with large values of the magnetic field contour. In addition, the intensity balance between the two different kinds of magnetic field has not been built. The magnetic field intensity inside the circular neutral lines are much more greater than those of the neighboring spots with opposite polarity.

3. Velocity field of photosphere and chromosphere

The photosphere and chromosphere velocity fields of AR6659 have similar velocity zero line configuration(Fig.1A) but have opposite velocity direction at some of the area.Velocity zero lines and magnetic field neutral lines are similar but have following trend: the red-shift areas of the velocity fields correspond to S polarity areas and blue-shift areas to N polarity areas.

4. Conclusions

1). The 4 flare nodes are all on the positions which locate between the spot umbrae and outside the circular neutral lines where the magnetic fields and velocity field gradient are the most and have violent extrusion and shearing motion. These all confirmed the results obtained in References (Li et al. 1988) and (Zhang et al. 1989) (Fig. 3,4,5).
2). The flare nodes all exist in the blue-shift area of the velocity field. The flare area not only covered the blue-shift areas but also the red-shift areas (Fig. 3,4,5). According to off-band observation of 9 June X10/3B flare, the flare brightness is enhanced along the red-blue direction (Fig. 2). This implies that the material of the flare and neighboring meterial flow coincidentally.

3). The material of the flares eject out along the direction of the vector fields(i.e. magnetic arc) and evoke induced flares at several tens of thousand KM distance from the region (Fig.3, 4,5). Some induction flares evoke secondary induction flares. The induction flares (thick line area) were born after the original flares(obique line area) have shorter lives but disappear before the original flares. Frequently, post-flare loop links the original flares and the induction flares.

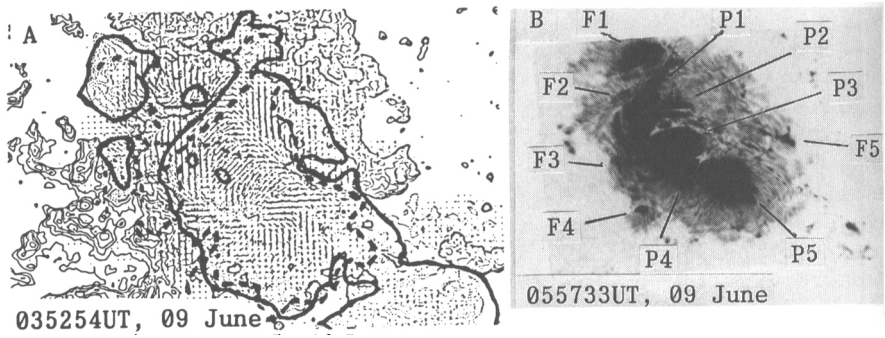

Fig.1 A. Vector field (5324A), neutral line of longitudinal field (solid 4861A) and velocity field zero-line (dashed 4861A). B. sunspot photo.

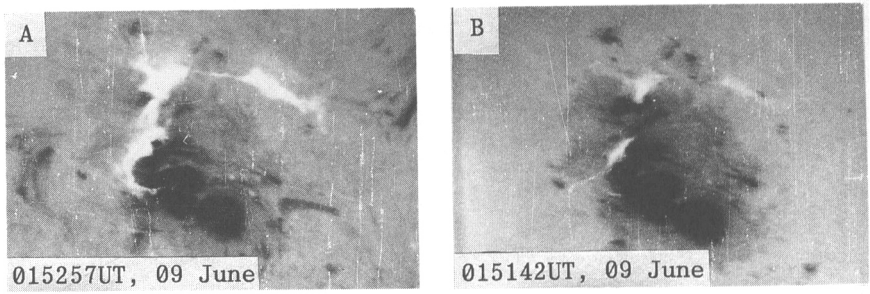

Fig.2 The off-band observation of the flare X10/3B.
A. +0.75A B. -1.50A

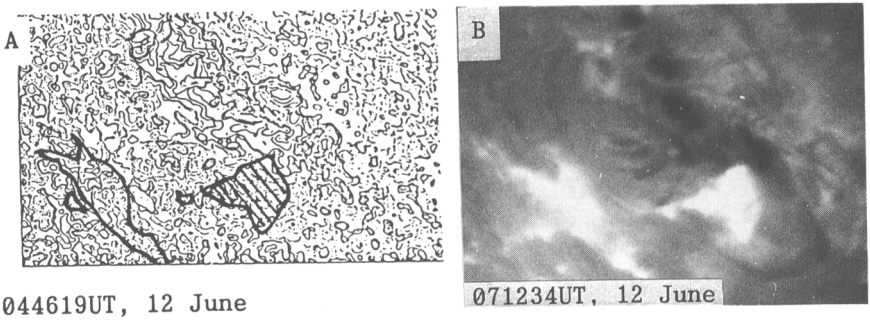

Fig.3 The relationship between the velocity field (A, 5324A) and the flare M2.5/2N (B).

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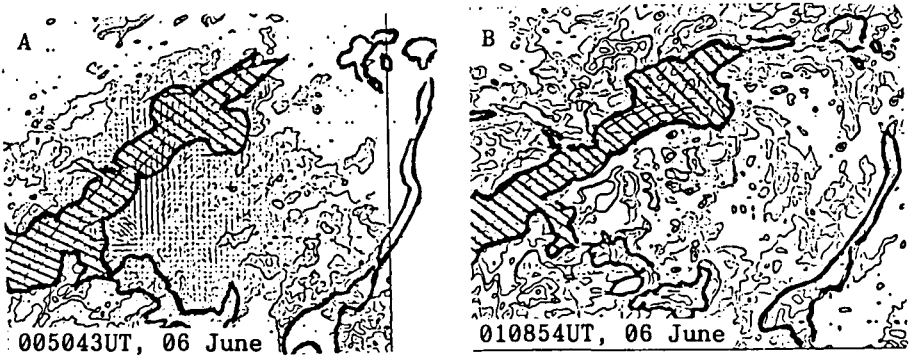

Fig.4 The Relationship between the flare X12/3B, vector field (A, 5324A) and velocity field (B, 4861A).

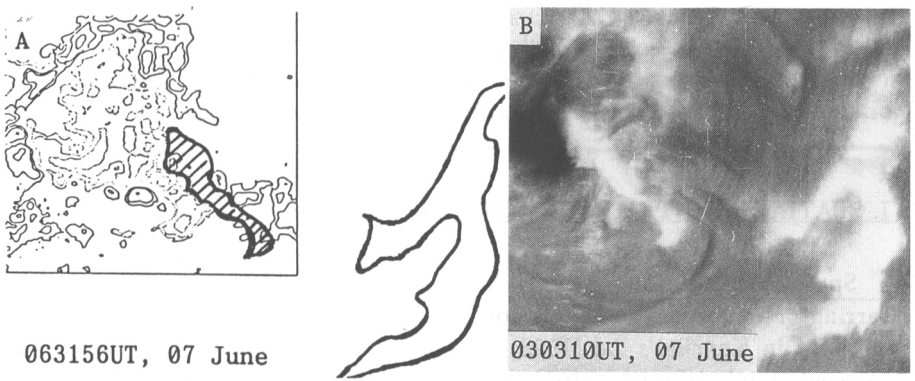

Fig.5 The relationship between longitudinal field (A, 5324A) and the flare M4.2/3B (B).

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