An Overview of AR 7260

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Abstract

A brief description of the observations of AR 7260 and its evolution are given. It is found that most of the flares occurred around Aug.20, while great magnetic shear built up due to new emerging flux and sunspot motion.

1. Introduction

AR 7260 appeared at the east limb on Aug.11, 1992 and rotated to west limb on Aug.24. The maximum area of this sunspot group was 1440x10^{-6} Hemi (Aug. 20) and its longitudinal extent up to 15° for 6 days, so it is a quite large sunspot group. From SGD we learned that 134 optical flares and 63 XR events had been recorded. However, more than 92% of them are subflares, and not a >1N flare or >M4 XR event has been observed. In this paper, by combination of the information from Huairou and Purple Mountian Observatory, a brief description of the data observed is introduced. Besides, some dicussions about the flare occurrence are presented as well.

2. Observations and Data

First we tentatively define E_o and E_x to measure the daily solar activity as follows:

$$E_o = N_s + 10N_1$$
$$E_x = N_c + 10N_m$$

where N_s, N_1 are the numbers of subflares and the numbers of class 1 flares per day respectively, and N_c,N_m the numbers of SXR events of class C and M per day. As known the energy released in a class 1 flare is about 10 times that of a subflare. So E_o and E_x might be roughly proportional to the daily energy released by outburst. From figure 1 it is noticed that the E_o and E_x changed in similar way and both reached maximum on Aug.20. The observations we made are listed in table 1. The photographic observations of Hα and white light became available since Aug.17 and the magnetogram even later.

3. Evolution and Activity

As the Huairou magnetogram was not available until Aug.20, we have to refer to Kitt Peak magnetograms published in SGD. Before Aug.17 both the p spot and the main part of following small spots appeared to be S polarity and both embedded in a quite large area of N polarity, resulting in a SNSN sandwith magnetic configuration. We looked up SGD and found this might relate to the evolution history of AR 7260 (table 2). There existed another active region 7232 last rotation, located near the same disk position, only 6° westward. AR 7232 faded away when it passed the meridian and no visibile spot could be detected for three days. It reappeared on July 25 as a normal bipolar group with a p spot of S polarity. It seems that AR 7260 developed

Table 1 A summary of observations of AR 7260.*

Date August	H_α	Time (UT) White	Magnetic fields	Time (UT) Start–Max–End	Importance optical	XR
17	0059–0341	0236–0334				
		0635–0705				
18	0131–0158	0612–0656				
	0240					
19		0257–0320				
		0628–0738				
20	0645–0837	0149–0327	0152	0616–0642–0702	SF	C2.0
		0615–0700		0710–0714–0814	SF	
21	0254–0317	0227–0259	0054	0251–0251–0259	SF	
			0612	0304–0323–0409	SF	C3.5
22		0120–0124	0458			
23	0748–0836		0636	0713–0715–0817	SN	C4.0
			0918			
24	0058–0153					
	0306–0317		0234	0307	SF	
	0654–0703		0412			

* Magnetic fields observations were made by BAO and H_α, white light by PMO. Listed in the last two columns are the corresponding SGD data.

Table 2 Evolution history of AR 7260

Carrination rotation number	Active region	Absolute heliographic longitude	Mean heliographic latitude
1858	7232	261	N16.1
1859	7260	255	N16.3
1860	7276	261	N15.5

on the remains of AR 7232 and formed a complex of activity.

An arch filament system (AFS) was detected in the east part of the group in $H\alpha$ on Aug.18(0158 UT). The appearance of AFS implies an emerging flux region (EFR) was growing. The magnetic flux kept emerging in this region by Aug. 20. Successive emergence of new dipoles caused stress and reconnection of magnetic fields and a series of flares occurred. The subflare (figure 3) occurred in the region where an AFS took place about 30 minutes ago.

Usually when an EFR comes up behind an older region, the p spot will plow through the f polarity. In AR 7260, we did find a small elongated (shear) spot of S polarity pushed westward at a speed of 0.05 km/s (Aug.19 to Aug.20), than accelerated to 0.3 km/s (Aug.20 to Aug.21). At the same time, a narrow region with polarity N stretched inside the back of S region. In company with the spot motion, a dark filament formed between the central N and moving S region, and both the filament and the magnectic inversion line moved westward at 0.12

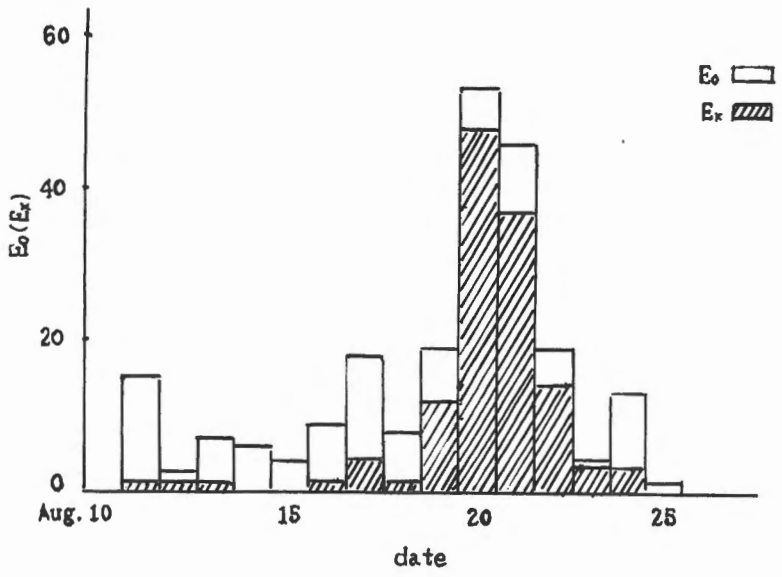


Fig.1 Active history of AR7260

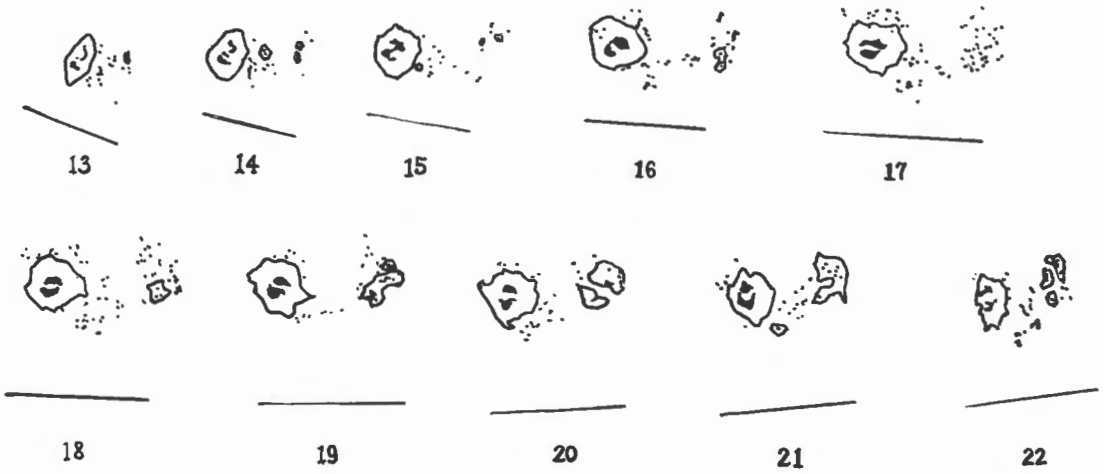


Fig.2 Daily sunspot drawing of AR7260. The lines under active region are paralled to the latitude circle

km/s, while the extent of the group almost kept constant. The motion of the spot caused the magnetic field highly sheared and the central N region was squeezed. The shear of flux line could also be confirmed by the vector magnetogram of Huairou (figure 4). A series of flares, say, the subflare of Aug. 21, resulted from the motion and magnetic shear occurred near the inversion line.

The spot stopped moving on Aug.21 and its shape turned to be round, a stable structure. The magnetograms show that the following S region merged

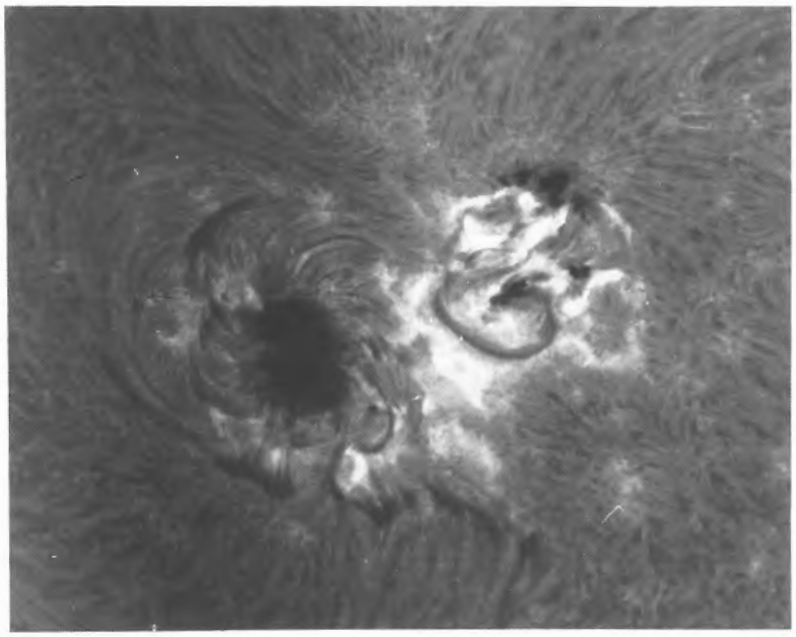
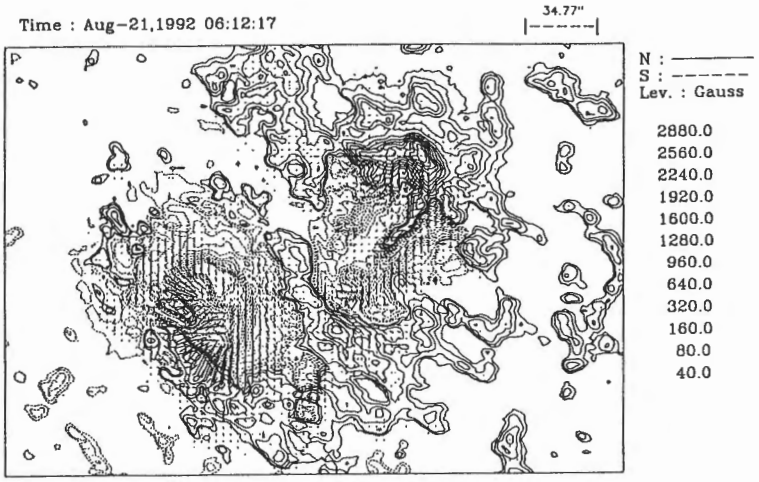


Fig.3
A subflare at Aug. 20, 1992 0717 UT. South is at the top and west is on the left.



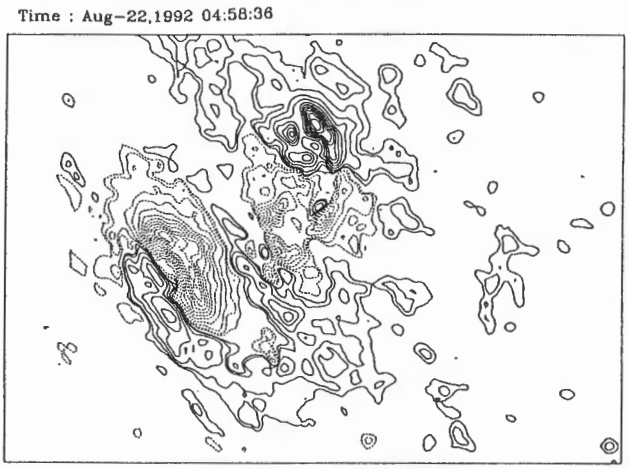


Fig.4
Magnetogram of Huairou

with the proceeding S region, first on the south part, resulting in the middle N region surrounded by S region like a peninsula on Aug.21, then almost merged in one on Aug.22, only some small regions of N remained. At the same time, the fragmentary regions of N in front of the large S spot merged in a large region of N. Two new filaments occured along the west and the north inversion lines. Some small flares and surges occurred in the north part and to the west of the large p spot. AR 7260 even recurred in next rotation (1860) as AR 7376. There must be magnetic flux successively emerging from beneath to keep the area active.

It is noticed that the relative position of three umbrae of the large p spot, as well as the magnetic axis of the group seem to rotate counter-clockwise. Having corrected the project effect, we find the rotate angles are, as listed in table 3, larger than the measure uncertainty (about $\pm 5°$). The rotation mainly took place between Aug.19 and Aug.23, the most active period. However, something not easy to explain is that the rotation made the f, not the p spot, closer to the equator, which is not consistent with the Joy law (Zirin, 1988).

Also detected in AR 7260 is the mass motion. The mass flows of 20–80 km/s were observed in a large spiral fibril-FTA for sevral times on Aug.18 and Aug.20. The fibril-FTA connected the west gap of two umbrae of p spot to a small N polarity far away (near the middle of the group). Both upward and downward flows were recorded, but usually blue shifts obtained near p spot. It seems that there existed a rather steady channel for mass and energy transport.

Table 3 Rotation of umbrae of p and the whole group

Date August, 1992	13	14	15	16	17	18	19	20	21	22	23
Rotation angle of the sunspot group*						0		4	10		14
Rotation angle of the umbrae of p*	65	65	65	58	63	67	65	78	92	95	

* The angle is measured from the latitude circle and increases when it rotated counter-clockwise.

Hence we conclude that AR 7260 was a long live active region. It survived due to successive emerging flux. But as the magnetic fields involved were not very complex and intense and the new p spot motion did not push westward so fast as usual (1 km/s). Many small flares occurred, but the energy level was not very high.

Acknowledgements

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Reference

Zirin, H. 1988, *Astrophsics of the Sun (Cambridge Univ. Press, Cambridge)*, p.307.