The Magnetic and Velocity Fields of Solar Active Regions
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THE PROTON FLARE AND EVOLUTION OF MAGNETIC FIELDS IN A DECAYING ACTIVE REGION

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ABSTRACT In this paper,the evolution history of longitudinal magnetic field of a decaying active region (NOAA AR6703) was studied. We also described the X1.9/4B flare occurring in AR6703, as well as the accompaning events, and emphasized in analysizing the features of longitudinal magnetic fields before the flare.

A class X and 10 class M X-ray flares occurred in a decaying active region AR6703 (NOAA) on July 1991. One of them was a proton flare. The staff of Shahe station of BAO observed the proton flare occurring at 7/0119 UT. The location of AR6703 was N30°, L240°, which got into the visible disk of the sun on 30 June and disappeared from the solar disk on 11 July.

I. THE EVOLUTION AND THE DECAY OF THE REGION.

AR6580 was an active region of long life. It rerotated three times. AR6703 was third rerotation of AR6580(NOAA). AR6580 appeared in the east of solar disk on 7 April 1991. It was a small and simple sunspot group, whose preceding and following parts presented a normal distribution. This active region grew rapidly and formed a δ structure while it was near the heliocenter. It went out of the visible disk on 19 April. AR6619(NOAA) was the first rerotation of AR6580 from 5 May to 18 May. AR6659(NOAA) was the second rerotation of AR6580 from 2 June to 16 June.

Figure 1 and 2 showed the feature of every rerotation of AR6580. When AR6580 appeared on the solar disk, the intensity of the longitudinal magnetic field was very weak. The S and N polarities of the magnetic field evolved into the south-north distribution while the region was near the heliocenter (Fig.1 (a)). The magnetic flux of S polarity was dominant when AR6619 had just rotated on the solar disk. However, the magnetic flux of N polarity rose quickly. When the region was near heliocenter, it presented the magnetic configuration like AR6580 (Fig.1 (b)). When AR6659 had just gone into the visible disk, it changed into the active region in which S polarity was dominant again (Fig.1 (c)). The stronger magnetic flux of N polarity marked by A located at the south-east of the flux of S

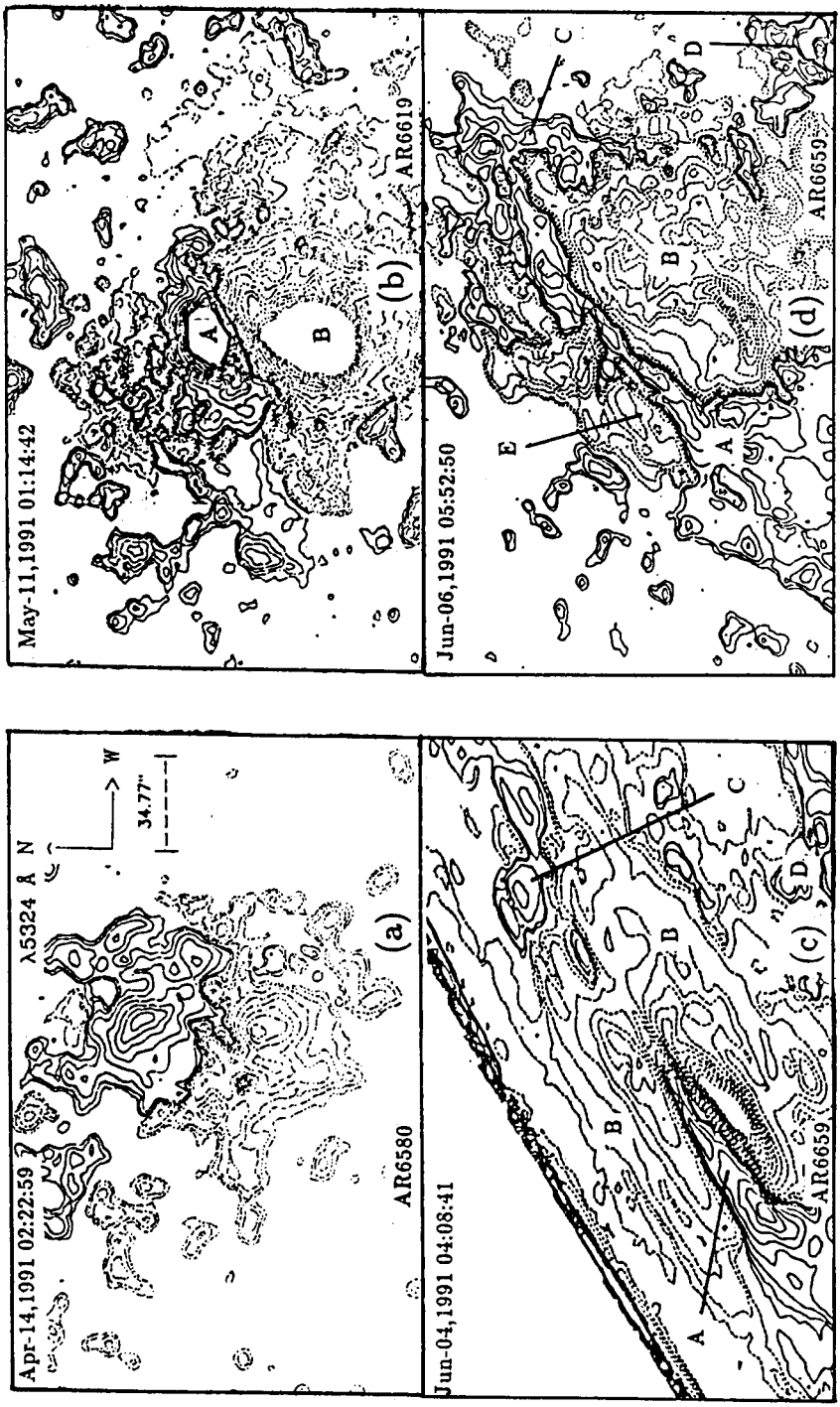

Fig. 1. The evolutions of the magnetic field of AR6580, AR6619 and AR6659.

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polarity marked by B, another two weaker fluxes of N polarity marked by C and D located at the north and at the south-west. The flux of N polarity, C, grew very quickly and incorporated with the flux of N polarity marked by A together on June 6 (fig.1 (d)). On 9 June and on 13 June, the splitting and the incorporation of the magnetic flux of same polarity occurred again. In the result, the active region changed into the region in which the magnetic flux of N polarity was a bit dominant. In conclusion, the magnetic field of AR6659 evolved fastest and the magnetic configuration was the most complex among several rerotations of AR6580. The basic form of the evolution was the incorporation of the magnetic flux of same polarity. This magnetic evolutionary feature closely related to the energetic flares (Guiqing Zhang, 1991). When AR6580 rerotated into the solar disk third time, the magnetic field of the region decayed obviously and scattered (Fig 2). However, this region changed to one of reverse polarity.

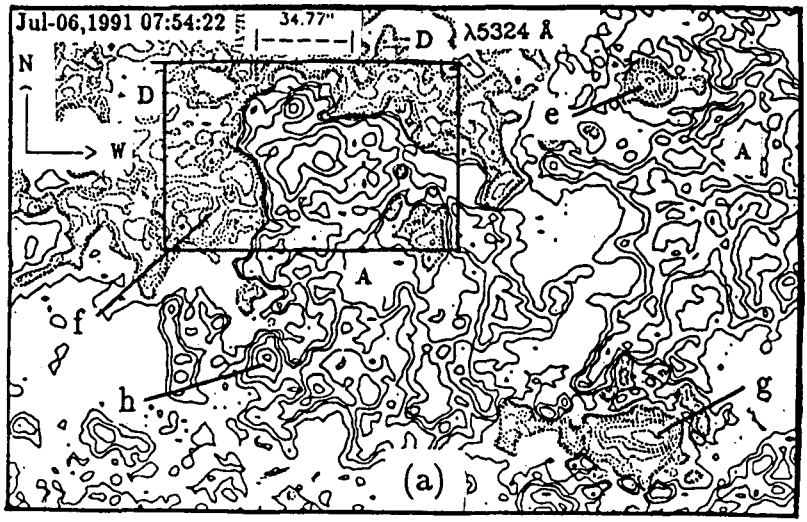

Fig. 2. The evolution of magnetic field of AR6703 and AR6711.

II. THE FLARE OCCURRED ON 7 JULY AND FEARTURE OF THE ACTIVE REGION.

A X1.9/4B flare mainly occurred in AR6703 at 7/0119UT. Part of the flare was located at AR6711 (Fig 3 (b)). Figure 3 show that the flare covered sunspots marked by e and h, and the most of sunspot marked by f. There was a small bright area near the spot, g. Corresponding, the peak flux of radio in 2840 Mhz was 1176 sfu, and the peak flux of relevant proton event was 2300 pfu. A strong SWF event(I= 2^+) accompanied the flare.

According to the sunspots on the photosphere (Fig 3 (a)), NOAA divided e, f, g and h into two groups, AR6703 (e and f) and AR6711 (g and h). Obviously, AR6703 and AR6711 were simple sunspot groups. The following of AR6703,

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f, was composed of many small spots, part of which was encircled by the pale penumbra.

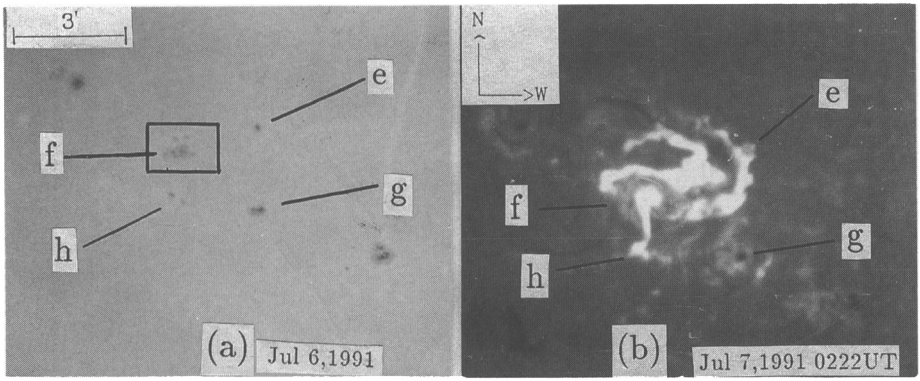

Fig. 3. The aspects of sunspot groups of AR6703 and AR6711 and the flare occurring in them at 7/0119 UT.

Figure 2 showed magnetograms of AR6703 and AR6711 on 6 July. It displayed a reverse polarity region just as mentioned above. Comparing the pictures of sunspot groups with the magnetograms of the active region, we know that actualy, AR6703 and AR6711 were composed of the most intense parts of the flux of N polarity in the preceding group marked by A and intense magnetic flux of S polarity that were mixed up within the preceding magnetic flux marked by A. The following magnetic flux marked by D had been very veak. e, f, g and h in Figure 3 corresponded with e, f, g and h in Figure 2. The part of sunspot marked by f was a small δ structure though the intensity of the magnetic field was quite weak. The inversion line of polarity was very winding and the longitudinal gradient was about 0.28G/km in δ structure. The reverse polarity, δ structure, stronger longitudinal gradient and winding inversion line of polarity in δ structure perhaps were inducer of the proton flare.

ACKNOWLEGEMENT

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REFERENCE

Guiqing Zhang, 1991, Acta Astrophysica sinica, 11, 362.