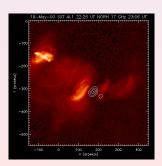
Moving magnetic features, loop-loop interactions and repeated flaring

Silja Pohjolainen Tuorla Observatory, Finland

NBYM04, Kiyosato Oct 26-29, 2004



Homologous solar flares

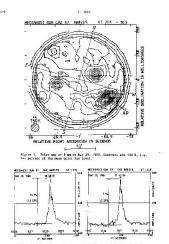


Figure 2. Two microwave bursts at 1026 UT and 1947 UT from the Hale

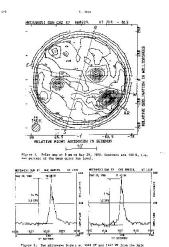
The Bela Yagion 1689) had also produced several optical homologous Clause hadren May 13, 1900, but as the Mahaya Chy See was not observed at that time. On they 29 optics) [large week-sported at 0727 CT and CLOOTT [2].

The elementary spikes can be intempreted as contributions from different negocial loops. The same complex regardle loop structure can be assumed to be present just before both derivaeyed burses, it is proposed that some instability, it, in moveraging ower magnetic loop, triggards.

Similar impulsive evolution at microwaves/millimeter waves

- Same footpoints (= same location)
- Near a large sunspot (= strong magnetic fields)

Homologous solar flares



region 1684.

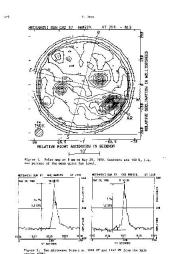
The Bels segion 1684 had also produced inversal optical homologous Claurs before May 13, 1960, box at Macadhay; the 5os was not observed at that time. On May 19 optical [large weeds.]

The elementary spikes can be intempreted as contributions from different negratio loops. The same complex supported loop structure can be assured to be present just harder both elementary the lawyers, it is proposed that some introductive, it, one corrupts over magnatic loop, triggarden

*eportod at 0757 ET and 1030 ET 121

- Similar impulsive evolution at microwaves/millimeter waves
- Same footpoints (= same location)
- Near a large sunspot (= strong magnetic fields)

Homologous solar flares



The Bela vegion 1884 had also produced several optical homologous Claims before May 23, 1800, but at managing the Sea was not observed at that thee. On bay 29 optical flares were reported at 0.000 ft and 0.000 to [2].

The elementary spikes one by interspected as contributions from different negacial loops. The same complex supported loop structure can be assured to be present just safers both elementary bursets. It is proposed that some instability, it, one corruing one magnatic loop, triggarden

- Similar impulsive evolution at microwaves/millimeter waves
- Same footpoints (= same location)
- Near a large sunspot (= strong magnetic fields)

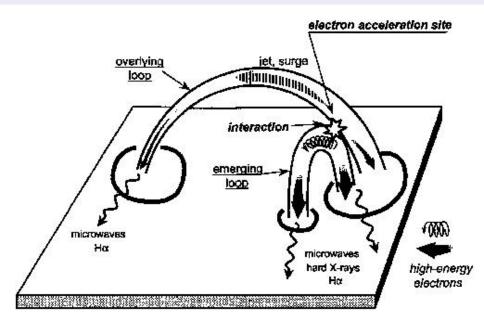
What lies behind

- Repeatedly emerging flux?
- Continual shearing and reconnection of similar structures (where not all magnetic free energy is released)?

What lies behind

- Repeatedly emerging flux?
- Continual shearing and reconnection of similar structures (where not all magnetic free energy is released)?

Emerging flux (Hanaoka, 1997)



What lies behind

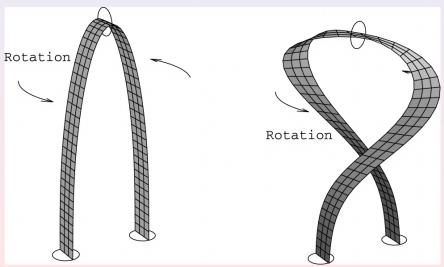
• Repeatedly emerging flux?

 Continual shearing and reconnection of similar structures (where not all magnetic free energy is released)?

What lies behind

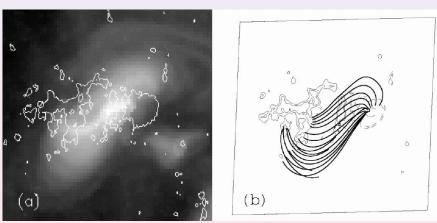
- Repeatedly emerging flux?
- Continual shearing and reconnection of similar structures (where not all magnetic free energy is released)?

Twist and shear and writhe: rotation



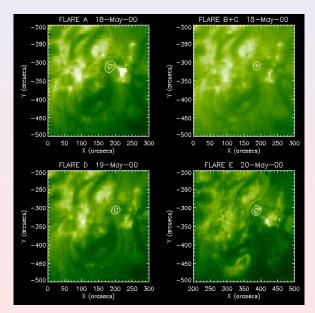
Lopez Fuentes et al. (2000)

Twist and shear and writhe: from shear to sigmoid

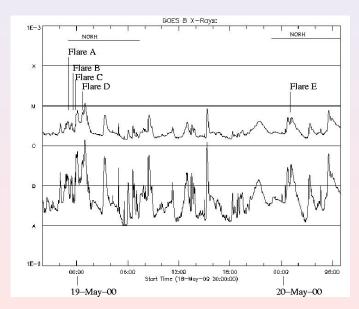


Lopez Fuentes et al. (2000): This leads to kink instability and eruption

5 radio flares from the same location AR 8996 (S20 W10...25)



Observations: May 18-20, 2000

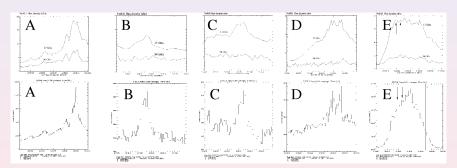


Observations: May 18-20, 2000

Table: Summary of flares in AR 8996 during 2000 May 18-20

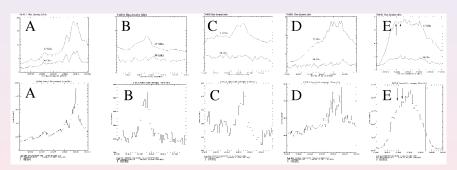
Name	Time of maximum	Maximum flux	BATSE peak count
	at 17 GHz	17 <i>G</i> Hz	c/s/2000 cm2
Flare A	2000 May 18 22:59:35	150 sfu	42417
Flare B	2000 May 18 23:48:56	15 sfu	1466
Flare C	2000 May 18 23:52:34	15 sfu	710
Flare D	2000 May 19 00:39:16	25 sfu	2839
	2000 May 20 01:06:27	80 sfu	19663

Radio and hard X-rays



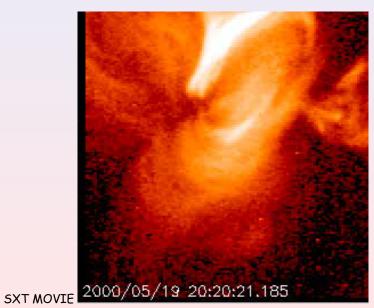
- Similar impulsive evolution in radio and in hard X-rays
- Total duration of each flare 1...2 minutes, two-peak structures

Radio and hard X-rays

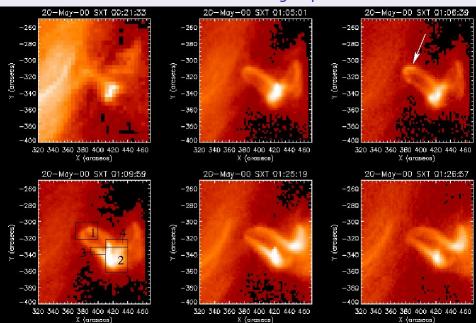


- Similar impulsive evolution in radio and in hard X-rays
- Total duration of each flare 1...2 minutes, two-peak structures

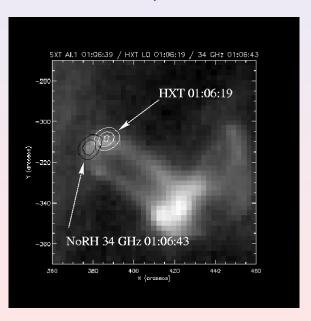
AR evolution in soft X-rays



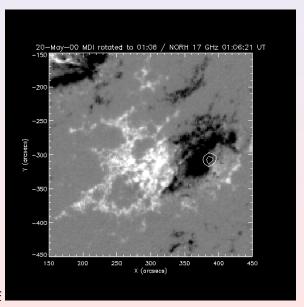
Flare E: interacting loops



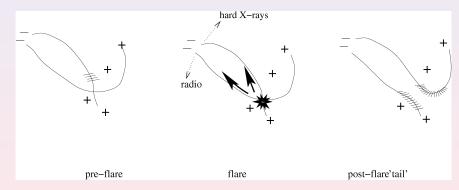
Hard X-ray and radio source locations



Flare location at the edge of a large sunspot region



Model for the repeated flaring



• for more details see Pohjolainen, Solar Physics 213 (2003)