FLARE ACTIVITY OF REGIONS WITH MAGNETIC DELTA CONFIGURATION

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ABSTRACT. The flares observed above the delta configuration are more energetic, comparing to other flares of the same region. The unknown trigger mechanism of flares does not depend on the delta configuration. The flare activity of the certain delta configuration is variable and is mainly a function of energy supply (kinetic and magnetic) and of processes of accumulation and release of energy. In addition to the flares, observed in expected sites of the four analysed regions (the place of an emerging new flux) there are some flares in unpreferred places. These flares probably resulted from relaxation process of the whole region, as they follow after other large flare in the same region. There is no substantial difference in occurence of flares above the sites of delta configuration and an emerging new flux.

ВСПЫШЕЧНАЯ АКТИВНОСТЬ ОБЛАСТЕЙ С ДЕЛЬТА КОНФИГУРАЦИЯМИ: Вспышки над дельта конфигурацией Более мощные в сравнении с другими вспышками той же самой области. Невнакомый спусковой механизм вспышек не зависит от дельта конфигурации. Вспышечная активность определенной дельта конфигурации изменчива. Она является функцией добавленя энергии (кинетической и магнитной) и процессов аккумулации и выделения энергии. В дополнении к вспышкам, наблюдаемым в ожидаемых положениях четырех избранных областей (это положения нового всходящего поля) возникают вспышки и в непредпочитанных положениях. Эти вспышки вероятно возникают в процессе релаксации области в целом, так-как они следуют во времени за большой вспышкой в той же области. Не было найдено основное различие в появлении вспышек над дельта конфигурацией и над положением всходящего поля.

ERUPČNÁ AKTIVITA OBLASTÍ S DELTA KONFIGURÁCIOU. Erupcie, ktoré vznikajú nad delta konfiguráciou sú energetickejšie v porovnaní s inými erupciami v tej istej oblasti. Neznámy spúšťový mechanizmus erupcií nezávisí od delta konfigurácie. Erupčná aktivita určitej delta konfigurácie je funkciou príkonu energie (kinetickej a magnetickej) a procesov akumulácie a uvoľnenia energie. Okrem

erupcií, ktoré boli pozorované na očakávaných miestach v štyroch analyzovaných oblastiach (na miestach vynárajúceho sa nového poľa) boli zistené ďalšie erupcie, ktoré sa vyskytli na nepreferovaných miestach. Tieto erupcie sú pravdepodobne výsledkom relaxačného procesu v celej oblasti, lebo časove nasledujú po inej veľkej erupcii v danej oblasti. Nebol zistený podstatný rozdiel vo výskyte erupcií nad delta konfiguráciou a v oblasti nového toku.

1. INTRODUCTION

The bipolar sunspot group is classical case of the stationary development of the spatially isolated local magnetic field on the Sun. It is known, that local field can be very complex in distribution of magnetic polarity. The complex magnetic region is result of spatial interaction of the few bipolar groups (or the convective destruction of the originally compact large flux tubes ?). An activity complex to be a group of active regions, located close to one another, which is being continually formed in the same place. The magnetic delta configuration (the two umbras of the opposite polarities in the same penumbra) are formed in the complexes of activity. The specific physical conditions for the neutral line above the delta configuration are discussed by Gelfreikh (1986). The flares, which are located above the delta configuration are very energetic (LDE, HXR, acceleration of protons). The appearance of large flares in regions containing delta configuration should be understood in a broader context as extreme cases of the interaction of the old and new magnetic flux (Antalová, 1967, Martin et al., 1983). In this connection the question rises: Is the frequency of flare occurence larger for delta configuration than for the places, which are characterized by a stigma of the new emerging flux? The purpose of this paper is to present a continuous review of flare activity in four selected regions, containing the delta configurations, to determine whether the enhanced flare activity above delta configuration is real.

2. THE FOUR SELECTED REGIONS

The study of the time development of the flares in the following activity complexes is given:

1. June 15, 1972, Mac Math 11926

The list and time development of the flares in the Mac Math 11926 are given in paper Antalová and Ogir (1984, Tab. 5). Direct proportionality was observed between the local occurrence of microflares and flares on the one hand, and the formation of the sunspots in the neighbourhood of the neutral line, never mind if it was above the delta configuration or above the place of the emerging new flux. These preferred locations had 5-7 times larger occurrence of flares than "normal" places of the neutral line of the region. The occurrence of flares in this region has character of pilses. There was simultaneously

increase or decrease of the flare activity in separate places, or in whole active region.

2. October 6, 1979, Hale 16341

The flare data are given in paper Antalová et al. (1985). The flare activity was the highest in the magnetically simple bipolar region Bou 2030, due to the change of the polarity of the large-scale field. The flares with the largest values of the comprehensive flare index occured in Bou 2032, containing the delta configuration.

The additive two ribbon flares occurred along the filament F5, on the western border of Bou 2032, where eas not the stigma of the newly emerging flux. This result is consistent with Martin et al., (1983) conclusion: at least 2/3 of the flares are intimately related to the emerging flux regions while the remaining 1/3 might be either indirectly related or unrelated to the emerging flux.

3. October 12, 1981, Hale 17906

The detailed analysis of this complex of activity will be published in paper Ogir and Antalová (1986). Schematic map photospheric and chromospheric structures is given on Fig. 1. Spots B and C of opposite polarities have a common penumbra and form the delta configuration. The ribbons of the LDE flare of Oct. 12/06:15 UT, 2B/X3, cover the umbrae of spots B and C. The eastern ribbon covers spot C and the western part of umbra B. The central H-alpha emission ribbon is located above the neutral line, to the left of B, and is marked as dot-dashed line. The development of the LDE flare (onset at 06:15 UT) is given on the Fig. 2. Besides of this LDE flare, which occurred above the delta configuration in the eastern (left hand) part of the complex of activity, there were three flares in the region of newly emerging flux (to the right of spot B).

4. June 4, 1982, SD No. 189

The detailed analysis of this complex of activity will be published in Antalová and Ogir (1987). This region was studied during the KAPG cooperation program (Borzov et al, 1986). The illustration of the flare locations is given on Fig. 3. The occurence of flares above the delta configuration was comparable to the places of the newly emerging flux.

3. CONCLUSSIONS

From the analysis of the above mentioned four selected regions it was found:

a/ The occurence of flares above the delta configuration is the function of the energy supply, its accumulation and release. There is no substantial difference in occurrence of flares above the sites of delta configuration and

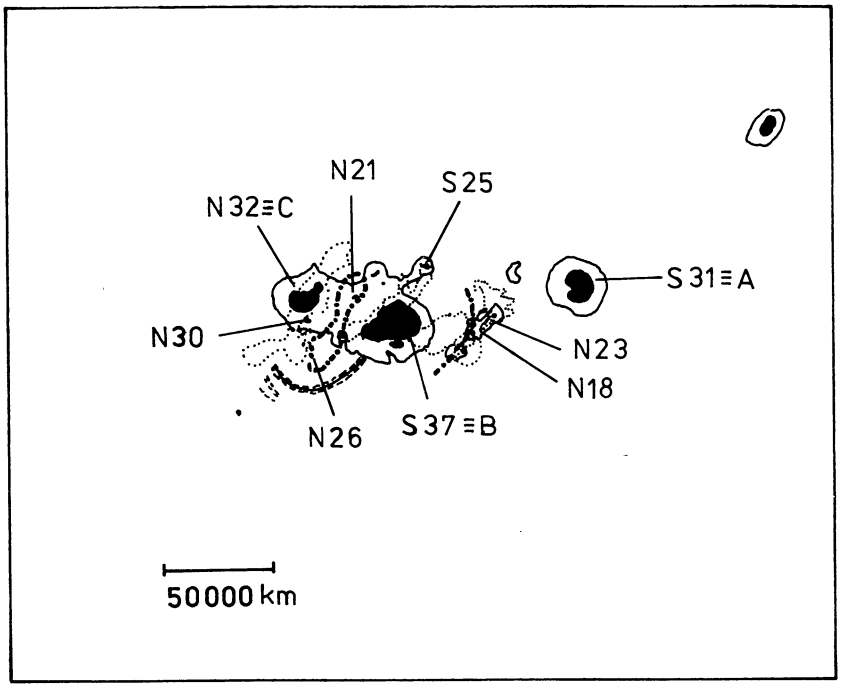

Fig. 1: The activity complex, Oct. 12, 1981, of two adjacent sunspot groups Hale 17901 and 17906. Spots B and C (Hale 17906) of opposite polarities have a common penumbra (the delta configuration). The three--parallel ribon LDE flare, 2B/X3, 06:15 UT, cover the umbrae of spots B and C.

an emerging new flux. When the energy supply to the delta configuration ceased, then the delta configuration is inactive.

b/ The flares occurring above the delta configuration are energetically intense.

c/ The trigger mechanism of flares is unknown.

d/ The flares which appeared at unexpected locations may be caused by a balancing mechanism of that region following the large flare.

e/ The flare activity in the given region has a character of a pulse. The time variations of the flare activity reflect the time profile of the energy input (delay time $\gtrsim$ 1 hour).

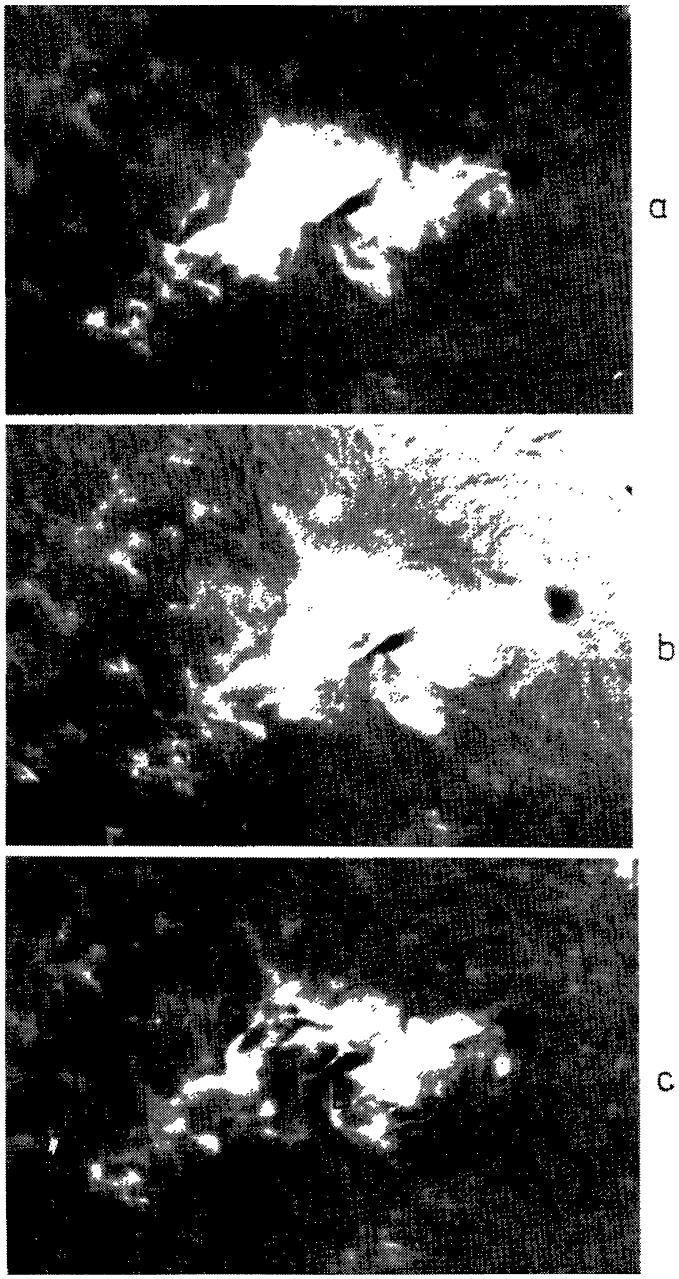

Fig. 2: The development of LDE flare, Oct. 12, 1981. a/ 07:37:30 UT. Conspicous bright three ribbon LDE flare (left of spot B). SN flare in Hale 17901, west (right) of spot B. b/ 08:21:00 UT, gradual phase of the LDE flare. c/ 10:23:25 UT, two ribbon flare in Hale 17901. The activity complex was observed by Dr. M. B. Ogir at the Crimean Astrophysical Observatory.

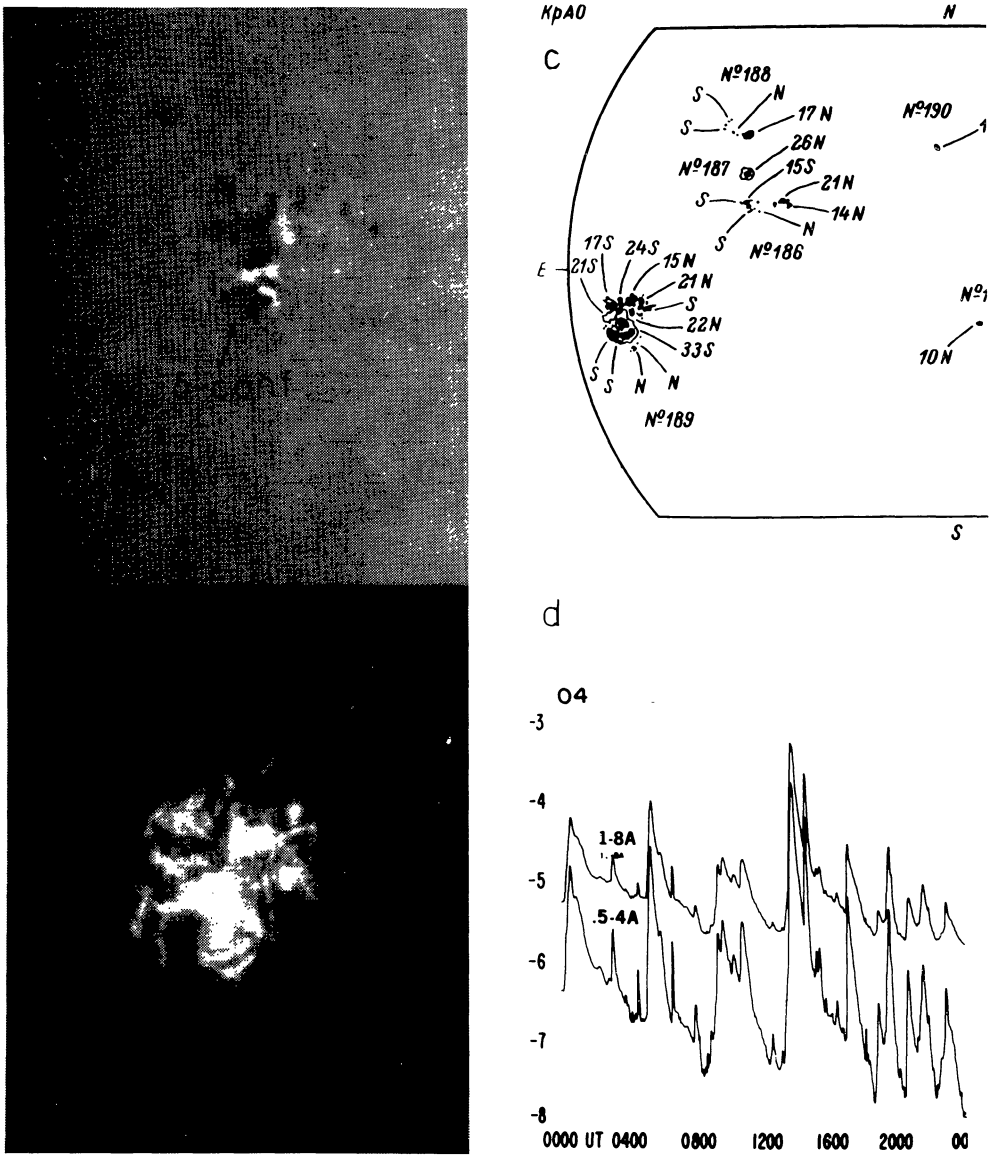

Fig. 3: The flares in June 4, 1982, SD No. 189. a/ 13:42:21 UT, the photospheric situation observed in the wing (-1.0 Å) of the H-alpha line. b/ 13:51:06 UT, gradual phase of flare. c/ sunspot group No. 189, taken from Solnechnye dannye, June 4, 1982. d/ The time variation of SXR on June 4, 1982, taken from SGD. The largest peak of SXR belongs to the flare, illustrated on Fig. 3a. The activity complex was observed in H-alpha by Dr. M.B. Ogir at Crimean Astrophysical Observatory.

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DISCUSSION

B. Kálmán
My question concerns the third flare ribbon of the flare from October 12, 1981. Is not possible, that the third bright ribbon between the two "usual" flare ribbons is the bright apex of a loop system, as was in the case of the flare October 5, 1979 ?

A. Antalová
Yes, the third central parallel ribbon is interpreted as the bright tops of the loops anchored in the "usual" ribbons. From development of October 12, 1981 flare it is clear, that post flare loops were localized higher than the central parallel ribbon.

G.V. Kuklin
Могли бы Вы сказать подробнее, что подрозумевается под "балансырованной" вспышкой, как Вы ее называете ? Связано ли это с балансом каких-либо физических характеристик ? Или же существуют какие-то особне условия для таких вспышек, кроме известных нам ?

A. Antalová
Физические условия для выделения энергии во вспышках двух видов должны быть сходными. После вспышки в ожидаемом месте области (с развитыми признаками нового магнитного тока) могут улучшиться условия для возникновения вспышки и в других местах области. Вероятно, в этих случаях, изменяется высотной профиль плотности, токов, скорости и вспышка возникает в непредпочитаемом месте области.

CONTINUATION OF DISCUSSION

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V. Bumba

На Вашем рисунке, показывающем изменение распределения магнитного поля в области вспышки видно, как будто-бы изменило одно пятно свою полярность. Это действительно так ?

B. Kálmán

Нет, это вообще не может быть. Дело в том, что изменения магнитного поля нарисованы на рисунок группы от 17 июля, а в данном месте было и движение пятен. Таким образом пятно не меняло полярность.

V. Bumba

Распад пятна, про который Вы говорите, наблюдается относительно часто. По моему опыту, из наблюдений создается впечатление, что это не только диссипация поля, но как будто-бы исчезли силы связывающие отдельные части ядра пятна, силы стабилизирующие форму ядер и всего пятна.

B. Kálmán

Да, это скорее всего не распад, а упрощение магнитной конфигурации.

DISCUSSION

to Lozitsky et al. contribution from page 273

V. Bumba: -

- Каким образом измерялось напряжение магнитного поля в линиях металов с эмиссией ?
- Каким образом учитывалась сложная картина расщепления линий металов в магнитном поле при измерении напряженности магнитного поля во вспышке ?

V. Vaculík:

При измерении напряженности магнитного поля во вспышке использовалась методика из работы: Лозицкая, Лозицкий: 1982, Письма в Астроном. журнал 8, 500.