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SOLAR FLARES IN CENTERS OF ACTIVITY WITH NO SPOTS

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ABSTRACT This paper presents a study of 9 "spotless" flares of H-alpha importance 1 or more which occurred in the years 1981-1990. The flares occurred in positions where no active region has been reported. All the flares were found to occur in evident and well-localized plages, large and diffusive plages as well as in regions where no plage was observed. Only one of all the flares studied in the paper was reported to be accompanied by the filament activity.

INTRODUCTION

Solar flares occurring in regions with no visible spots, which are used to be named "spotless" flares, have usually not been of the main interest of solar physicists. Despite, these relatively rare, although very interesting solar active events, were studied in more or less detail in the past (Dodson and Hedeman 1970; Dodson et al. 1979; Ruždjak et al. 1987; Ruždjak et al. 1989). It is generally believed that the "spotless" flares are still related to weak magnetic fields commonly associated with H-alpha and Ca+ plages.

FLARE CHARACTERISTICS

The H-alpha flares of importance 1 or more which occurred at Central Meridian Distances less that 65 degrees and at positions where no "official" active regions were observed, as reported in "Solar-Geophysical Data" (SGD), are examined in this paper. For 4 of the events (Nos. 2, 6, 7, and 8) at least one observatory indicated a parallel ribbon structure (flare descriptor "U" in SGD), i.e., they were the "two-ribbon flares. No but one (No. 4) filament

activation or disruption was reported to have accompanied all of the flares. However, a H-alpha spray has been observed after the March 11, 1985 flare. Although possible eruptive active region prominence was observed after the April 14, 1983 flare, an association with the studied flare seems to be not very clear (two 2N flares started approximately at the same time). As to radio emission of the studied "spotless" flares, an association of microwave bursts at frequencies higher than 2.0 GHz and the related "spotless" flares seems to be evident in three events (Nos. 1, 6, and 7). In the case of the remaining flares the association is ambiguous as other significant flares started close to the start-time of the studied "spotless" flares (descriptor "?" in the g) column of Table I). The August 6, 1981 flare was accompanied by type III (decim-, metric, and dekam-) as well as type V (metric) radio bursts. A large group of type III metric bursts followed the July 11, 1982 flare. At soft X-ray (SXR) wavelength, the events were characterized by low fluxes (no available data on the flares No. 3, 5, and 9), which did not exceed M1 class in the GOES 1-8 A channel. One of the flares (No. 7) was accompanied by a week hard X-ray burst (Dennis et al. 1992). This flare, is reported to be associated with a "Sudden Ionospheric Disturbance" (SID) effect.

TABLE I Spotless Flares Data

a)	b)	c)	d)	e)	f)	g)	h)	i)	j)
1.	1981 Aug. 06	0339	S18 E42	122	2F	9.4/10.0	C4	3	EG
2.	1982 Mar. 29	0410	S28 E47	32	1N	2.0/8.0(?)	C7	2	GU
3.	1982 Mar. 30	0607	N26 E04	39	1N	15.4/81.0(?)	??	?	EGJK
4.	1982 Jul. 11	0715	N22 E66	27	1N	35.0/199.0(?)	M1	?	DEGL
5.	1983 Apr. 14	0839	S14 E49	50	2N	3.0/19.0(?)	??	?	BG
6.	1983 Jul. 22	0746	S14 E26	55	1N	9.4/4.0	C2	?	FGU
7.	1984 May 10	0115	N16 E65	125	1F	17.0/41.0	C4	5	EFGIUV
8.	1984 Jun. 08	0730	S22 W51	90	1N	no reported	C5	4	GU
9.	1985 Mar. 11	0621	N09 W23	34	1N	no reported	??	?	DG

a) - flare number
b) - flare occurrence date
c) - start of a flare in H-alpha
d) - flare position
e) - flare duration in H-alpha
f) - H-alpha importance of a flare
g) - significant microwave radio burst [GHz/s.f.u.]
h) - soft X-ray class of a flare
i) - decay of soft X-ray effect [hours]
j) - flare characteristics [the SGD symbolism]

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ACTIVE REGION CHARACTERISTICS

The active regions which produced the "spotless" flares studied in this paper were: a) evident active regions visible at the H-alpha filtergrams as well as at the Kitt Peak and Mount Wilson daily magnetograms, respectively; b) faint (small or great) diffusive plages; c) regions where no distinct plage as well as H-alpha or magnetic region were observed. As to the evolution of flare active regions as well as of those occurred near by the position where the flares started, most of the flares occurred during the "spotless" phases of the active regions which either have been significant and flare productive in previous rotations or will become active in the following rotations. However, there have been found two flares (Nos. 1 and 9) which occurred in surprisingly "quiet" regions. The August 6, 1981 "spotless" flare occurred approximately 8-10 degrees from the distinct Hale active region No. 17777. Although no active region was visible, very small, faint magnetic islands of positive polarity may be guessed in the flare position. Similarly, the March 11, 1985 "spotless" flare occurred at distance 8-10 degrees from the small NOAA/USAF active region No. 4632 which became visible in H-alpha only a few hours (less than 15 hrs.) before the start of the flare. Also the March 30, 1982 "spotless" flare seems to be associated with the emergence of the new magnetic flux near by Hale active region No. 18282; the emergence of 3 small calcium plage islands was evidently visible to evolve in the north part of active region (Big Bear Solar Obs.).

CONCLUSION

This paper presents the study of the 9 "spotless" flares, which occurred in the positions where no "official" active region has been reported (SGD). In contradiction to the results of Dodson and Hedeman (1970) and Dodson et al. (1979), who found that the "spotless" flares are generally associated with a large, dark, previously existing filament, only one of all the flares (No. 4) studied in this paper was evidently associated with the filament activation (SGD). Two of the flares seem to be associated with the emergence of the new magnetic flux either directly in or close to the flare position. Some flares have shown features of major events; the "two-ribbon" structure, SID effect, microwave radio and hard X-ray bursts (although of low peaks), and long decay time of SXR effects.

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