out by A. B. Severny[8,9] instability of plasma in such conditions must lead to the appearance of flares accompanying by the generation of high-energy protons up to relativistic energies.

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INTERNATIONAL CONFERENCE ON COSMIC RAYS AND THE EARTH STORM Part II

II-5-4. Some Features of Chromospheric Flares and Its Corresponding Active Regions Responsible for Forbush-Effect*

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An attempt was made to reveal some features of solar flares and its active regions by analysing flares of importance 2^+ and more responsible for Forbush decrease.

Data of IGY are used. It was shown that solid angle of outburst exciting Forbush-effect is the same as from magnetic storm's data. A dependence between amplitude and duration of effect in cosmic rays and longitude of corresponding solar flare was revealed.

The flares connected with Forbush-effect have larger duration, area in the maxima and larger intensity in H_α. There is no dependence between strengths of magnetic field in active region and amplitude of effect in cosmic rays.

1. It is very important to study a connection between the parameters of Forbush-effects and those of corresponding solar flares (and its active regions) for clearing up some features of a corpuscular streams (responsible for SC magnetic storms) and understanding the mechanism of its outburst.

The parameters of Forbush-effects found in Refs. 1, 2 and 3 were compared with some parameters of solar flares and their active regions on the day of the flare. The data for the comparison were Refs. 4, 5 and 6, and "Catalogue of solar magnetic fields" prepared at the Crimean Astrophysical Observatory.

2. First of all it was interesting to know whether there is a connection between an importance of the flare and its heliographical co-ordinates on one side effectivity of the flare in exciting of Forbush-effect on the other side. The data about the flares of the importance more than 2^+ were used. It was found that among 7 flares of the importance 3^+ six were effective, and among 31 flares of the importance 3 and 82 of the importance 2^+ there were accordingly 8 and 7 effective ones.

A dependence between a number of the

* This paper was read by A. I. Lebedinsky.

effective flares and their longitudes was shown in Fig. 1 (white—all flares, blackened effective only). It can be seen that the majority of flares (>76%) is concentrating in the interval ±40° from the central meridian (CM). Besides there is a little concentration of effective flares of the importance 2^+ and 3 to the CM. For example, mean longitudes of the flares of the importance 2^+, 3 and 3^+ are accordingly 23°, 25° and 39°. For this group the flares' durations and their areas in the maximum are larger for the events outside of a ±40° zone than inside it. In Fig. 2 there was plotted the dependence between the amplitude of Forbush-effect (neutron monitor[1,2]) and the longitude of the corresponding flare. There is a tendency for the mean amplitude to grow with the increasing of the longitude so that there does not exist a small amplitude at large distance from CM. This is the real tendency for there is a dependence between the duration of the Forbush-effect and the co-ordinate of the flares. (Two examples of such a dependence were given in Figs.3 and 4: For longitudes (Fig. 3) and for distance from the center of solar disk $R=\sqrt{\lambda^2+\varphi^2}$ where λ and φ are longitude and latitude of the flare accordingly). There must be the dependence of the Figs. 3 and 4 if the dependence of the Fig. 2 is real because there is a relationship between amplitude of Forbush-effect and its duration[7].

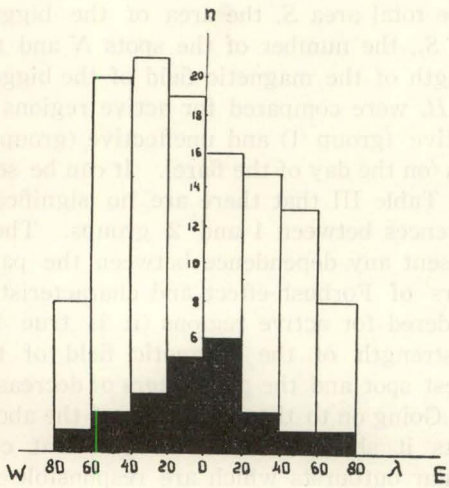

Fig. 1. The dependence between the number of the effective flares and the flare's longitude (n-the number of events, λ is the longitude in the degrees).

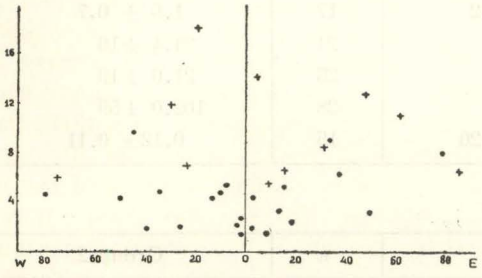

Fig. 2. The dependence between the Forbush-effect's amplitude and the flare's longitude (in y-direction: amplitude in per cents, in x-direction: the flares' longitude from the CM, W: west, E: east).

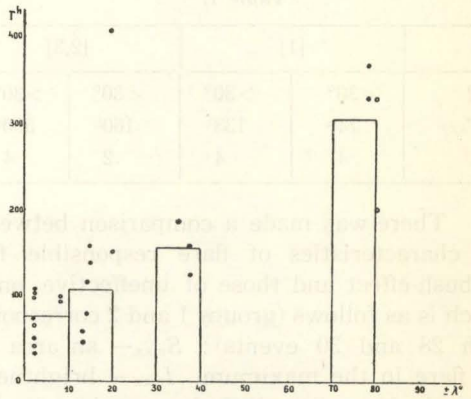

Fig. 3. The dependence between the Forbush-effect's duration and the flare's longitude (in y-direction: duration in hours, in x-direction: longitude in the degrees; the black points: from meson telescope's data, the circles: from neutron monitor's data).

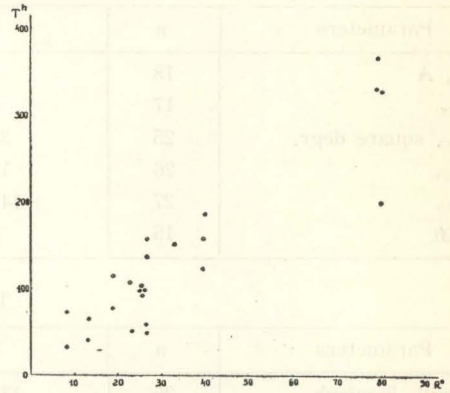

Fig. 4. The dependence between the Forbush-effect's duration and the distance from the solar disk's center (in y-direction: duration in the hours, in x-direction: distance in the degrees).

The line correlation's coefficient for Figs. 3 and 4 are equal to $+0.7\pm0.2$ and $+0.6\pm0.1$ accordingly. If the duration of Forbush-effect could not be measured it was defined as $T_{eff}=A/V_r$, where V_r is the intensity recovery at some initial period (A is the amplitude). The presence of the correlation for these events can be seen in Table I (here n is the number of the events which were taken from Refs. 1, 2 and 3). There is no dependence between co-ordinates of the flares and the hardness of variation's spectrum of Forbush-effect and the velocity of the stream (on the line sun-earth; the same is correct for the velocity of the intensity decrease).

Table I.

	[1]		[2,3]	
R	$<30°$	$>30°$	$<30°$	$>30°$
T_{eff}	74^h	133^h	160^h	590^h
n	4	4	2	4

3. There was made a comparison between the characteristics of flare responsible for Forbush-effect and those of uneffective ones which is as follows (groups 1 and 2 correspond with 28 and 30 events): S_{max}— an area of the flare in the maximum, I_{max}— brightness respectively undisturbed chromosphere in the maximum, maximum width of the line H_α, the time of the growth of the brightness Δt, the velocity of the growth of the brightness $\Delta I/\Delta t$ and the duration of the flare T. The results of this comparison were shown in Table II where there are averaged for both groups and its RMS deviations. Further, for each parameter the distribution was plotted. An analysis shows that the difference between the groups for the duration, the brightness and the area are real. The reality of this differences are confirmed by the presence of the positive correlations between the amplitude of Forbush-effect and the duration of the flare[1)] and between the same amplitude and the area of the flare in the maximum (coefficient of line correlation $+0.6\pm0.2$). The difference in the velocity of the growth of the brightness is explained by larger brightness in the group 1. There is no dependence between parameters of Forbush decrease and the width of H_α of the flare.

The total area S, the area of the biggest spot S_s, the number of the spots N and the strength of the magnetic field of the biggest spot H_s were compared for active regions of effective (group 1) and uneffective (group 2) flares (on the day of the flare). It can be seen from Table III that there are no significant differences between 1 and 2 groups. There is absent any dependence between the parameters of Forbush-effect and characteristics considered for active regions (it is true for the strength of the magnetic field of the biggest spot and the parameters of decrease).

4. Going on to the discussion of the above results it should be pointed out that corpuscular outbursts which are responsible for

Table II.

Parameters	n	Group 1	n	Group 2
H_α, Å	18	5.0 ± 2.5	21	3.9 ± 2.3
I_{max}	17	2.9 ± 1.2	17	1.5 ± 0.7
S_{max} square degr.	25	32.8 ±23	24	24.4 ±10
Δt_{min}	26	19.6 ±12	25	21.6 ±19
T_{min}	27	140.0 ±83	28	102.0 ±59
$\Delta I/\Delta t$	15	0.27± 0.20	15	0.12± 0.11

Table III.

Parameters	n	Group 1	n	Group 2
S mill. hemisph.	26	1394 ±1520	27	1123 ± 893
S_s mill. hemisph.	26	623 ± 415	27	543 ± 511
N	26	39.6± 27	27	38.6± 24
H_s hundred gauss	21	22.6± 5.6	25	21.6± 5.8

the Forbush-effect have not always such a large angle as it shown in Ref. 8. These results are in a good agreement with those found from magnetic storm's data[9,10]. An existence of a dependence between the amplitude (duration) of Forbush-effect and the longitude of the flare could be understood qualitatively assuming that the amplitude of the effect itself does not depend from the longitude, but there is a dependence on the importance of the outburst. This correlation could be explained by the dependence of the solid angle of the stream from its importance. The absence of the little amplitudes of the effect in cosmic rays at a long distance from CM is explained by a missing of a correspondent stream into the earth because they are thrown out in a narrow solid angle. This assumption is in a good agreement with the tendency to a concentration of a small effective flares near the CM. The other possible way of the explanation is the assumption that the corpuscular stream has a structure, so that the regional parts of the stream (in the plane of earth's orbit) have influence upon intensity much effectively. The comparison of the group of the flares and the presence of the correlation between flare's duration and the area in the development's maximum on one side and amplitude of the Forbush-effect on the other side demonstrate that:

1) the probability of the effect in cosmic rays rises with increasing of the importance of the flare;

2) there is statistical dependence between amplitude of Forbush-effect and the importance of the flare.

From the absence of any differences between the groups 1 and 2 in the Table III we get an evidence that effect in cosmic rays is connected rather with the flare itself than with considering features of the active regions where the flare took place.

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