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Forbush-decreases in cosmic rays for March and October, 1991 for data of spectrograph on the basis of neutron monitor.

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ABSTRACT
In this paper the organization principle of spectrograph realized on the basis of the monitor 24NM64 is presented. Forbush-decreases for March and October, 1991 are considered proceeding from the observation data. The spectrum parameters of the primary variations of cosmic rays and the change of the geomagnetic cut-off rigidity were found. The obtained results permited to show the resources of such a spectrograph.

1 Introduction:

To carry out the surface observations of the secondary cosmic rays the neutron monitor is used which at present time is the main instrument of the world network of the cosmic ray stations. It gives the possibility to obtain the continuous information about the processes in the interplanetary space and the Earth's magnetosphere using the neutron monitors placed on the different height in the atmosphere (the mountain spectrograph) or in the observation post with the different rigidity of geomagnetic cut-off (Dorman 1975, Dvornikov 1991). In this case the network of the cosmic ray stations is considered as the unit instrument. Yanchukovsky (1991) has suggested the method of spectrograph realization on an effect of local generated of neutrons on a basis of the continuous registration of the multiplicity of neutrons generated in the monitor medium by the cosmic rays.

2 Method Of The Multi-Channel Registration:

In this case the neutron monitor fulfils the role of the multi-channel instrument-spectrograph, in its n channels the registration of the integral spectrum of the multiplicity of the local generated neutrons $I(\geq m)$ (Yanchukovsky et al., 1995). The threshold of the first channel ($n=1$) is conditioned by the rigidity of geomagnetic cut-off of the observation point R_C. The thresholds of the another channels n are concerned with R_C by such relation

$$R_C = F(n)\, R(n). \tag{1}$$

The resolution of this instrument is conditioned by the coupling coefficients of the channels. From the latitudinal effect we have obtained the unnormalized coupling coefficients for the channels (Yanchukovsky, Philimonov 1995) in the next form

$$\frac{dI_{R_c}(n)}{dR_c} = \frac{a(n) I_0 dcF(n)}{[F(n)R_c + b]^{c+1}} \exp\{-\frac{d}{[F(n)R_c + b]^c}\}, \tag{2}$$

here $a(n)$ is the ratio of the intensity registered in the channel n to the intensity in the channel n = 1; b = 1.2; c = 1.0864; d = 16.0123. The value I_0 = 9.26 $m^{-2}s^{-1}$ corresponds to the epoch of solar activity minimum and the home monitor NM-64. The parameters values are found for the atmosphere depth h=1000 mbar. The coupling coefficients (2) are tied up with the normalized polar coefficients by such a relation

$$W(n, R) = \frac{1}{a(n) I_0} \cdot \frac{dI_{R_C}(n)}{dR_C}. \tag{3}$$

The transition from the polar coefficient (at $R_C \to 0$) to the coupling coefficient at the observation latitude $V(n,R)$ (at $R \to R_C$):

$$V(n,R) = W(n,R) / \alpha_0, \qquad (4)$$

is realized by means of the coefficient of over normalisation α_0

$$\alpha_0 = \int_{Rc}^{\infty} W(n,R)dR. \qquad (5)$$

Then the variations of intensity registered in the channel n of such a spectrograph can be presented in the next form (Dorman 1975)

$$\frac{\Delta I(n)}{I(n)} = \frac{1}{\alpha(n)} \int_{Rc}^{\infty} \frac{\Delta D(R)}{D(R)} V(n,R)dR - \Delta R_c V(n,R_c), \qquad (6)$$

here, proceeding from (1), $\alpha(n)$ is the normalizing coefficient

$$\alpha(n) = \int_{Rc}^{\infty} \frac{dcF(n)}{\alpha_0 [F(n)R+b]^{c+1}} \cdot \exp\{-\frac{d}{[F(n)R+b]^c}\}dR, \qquad (7)$$

and the spectrum $\frac{\Delta D}{D}(R)$ is usualy presented in the form $BR^{-\gamma}$ for the wide class of variations (Dorman 1975). According to (6), it is proposed that the barometric effect was taken into account in initial data. In going so, the barometric coefficients were used which we have obtained earlier for the each channel n (Yanchukovsky 1997). Accepting $\frac{\Delta I(n)}{I(n)} = J_n$, $\int_{Rc}^{\infty} R^{-\gamma} V(n,R)dR = A_n$, $V(n,R_c) = V_n$, we transform the equation (6) to the next form

$$J_n = BA_n - \Delta R_c V_n \ . \qquad (9)$$

The decision of the equation system (9) is carried out by the standard methods.

3 Discussion Of The Observation Results:

Fig. 1 presents the observation results during Forbush-decrease for March and October, 1991. The initial data of the intensity registration in % are shown in Fig.1a (figures nearly the curves show the number of channel). The initial observation data of Forbush-decreases were beforehand smoothed by the moving averadge (3 hours, tenfold smoothing). These data are used to determine the parameters of the variations primary spectrum γ and B (Fig. 1b,c). The variations of the geomagnetic cut-off rigidity during the Forbush-decrease of cosmic rays and *Dst*-index are shown in Fig. 1d (*Dst* Indices 1992). Using the obtained data for ΔR_C and *Dst*, we have tried to estimate the parameters of variations of the magnetospheric current system in the context of the model of the thread-like ring current (Dorman et al. 1971). The estimates of the magnetic moment M_K and radius r_k (corresponding in the Earth's magnetic moment and Earth's radius) and the ring current strength I_k (in 10^6 A) are presented in Fig. 1e, f and 1g.

4 Conclusion:

The multichannel registration of the cosmic rays variation based on the multiplicity of local generation of neutrons in the supermonitor expands of the neutron monitor possibility and it can be effectively used to analyze of the temporal variations of the cosmic rays. The resolution of method is essentially conditioned by the channel characteristics (on the one hand, by the difference of the coupling coefficients and the other hand, by the statistical accuracy of the intensity registration in the channels). The decrease of the account rate with increasing n of channel is first conditioned by the decreasing power spectrum of the registered radiation. The multichannel registration permits to choose the optimum relation between the necessary difference of the coupling coefficients and the sufficient statistical accuracy of registration when the concrete event is registered.

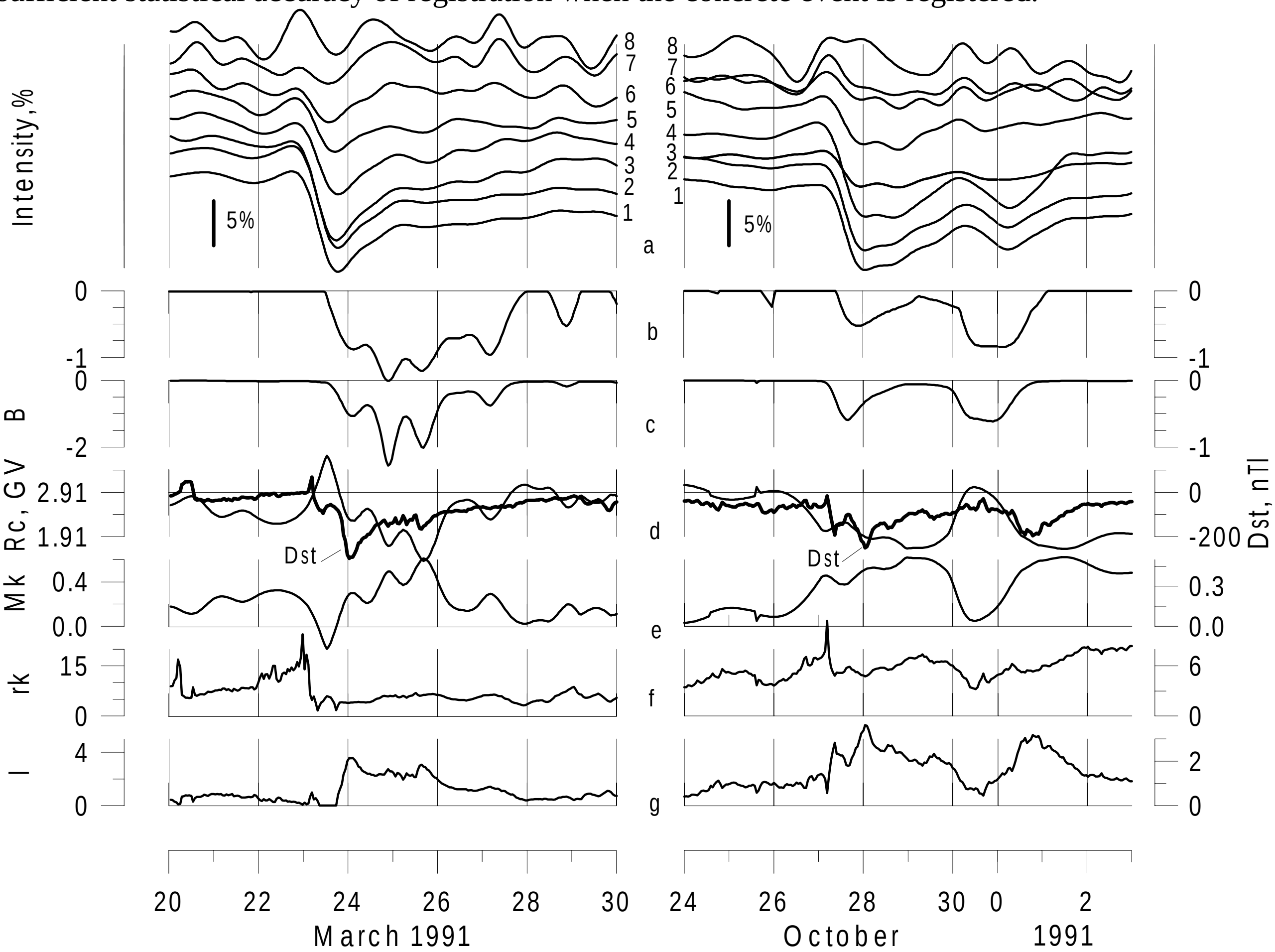

Fig.1 Forbush-decreases in cosmic rays for March and October, 1991

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