SEASONAL and 5 – YEAR GALACTIC COSMIC RAY VARIATIONS

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Abstract

In the paper the results of 5-year and seasonal variations of galactic cosmic ray investigation results are presented. The variations amplitudes, energy spectra and N-S asymmetry were calculated, time change of this characteristics was investigated. The calculations were carried out on basis of stratosphere registration cosmic ray total ionizing component (about 50 000 flights) data which allow to use the Earth atmosphere as an energy spectrometer. The possible interpretation of observed effects is given.

Introduction

Research of different mechanisms of galactic cosmic ray (GCR) modulation in the periods of solar activity (SA) maximum, minimum, decrease and growth is of interest. Investigation of 5-year variations gives the possibility to do it. Seasonal variations is investigated from a position of manifestation of magnetic window when intersection of helioequator by Earth.

Results

In fig.1 the frequency spectrum of galactic cosmic ray variations from 0.5 to 9 years is shown.

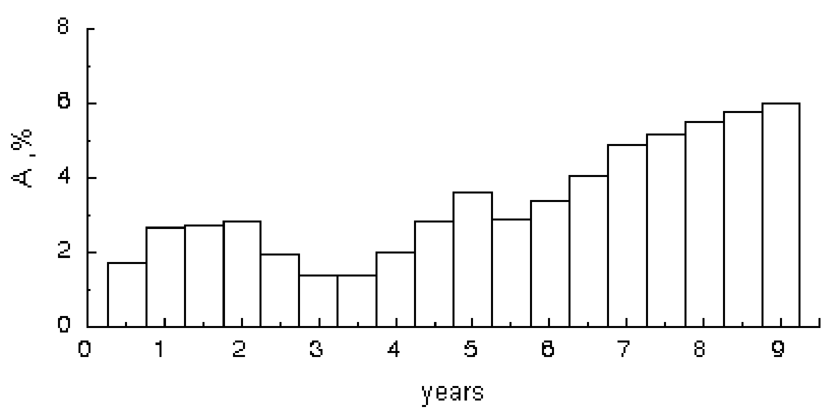

Fig.1 Frequency spectrum of galactic cosmic ray variations

It is seen from fig.1 that 5-year variations and variations with period of 7 and more year pick out particularly. The nature of 5-year variation is not clear at the moment, but we consider that is variation due to corresponding SA change because of gravitational influence of planets on SA [1,2].

In fig.2 the change of seasonal and 5-years variations amplitudes in time is presented.

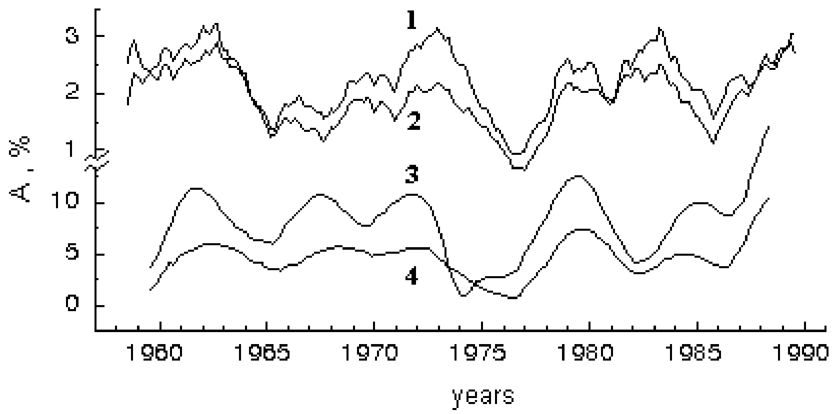

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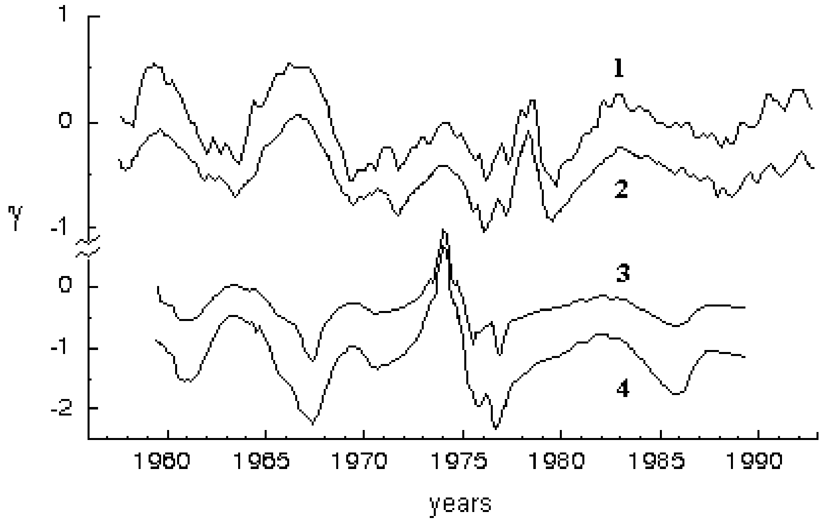
Fig.**2** Change of seasonal (1,2) and 5 – year (3,4) in time

(1 - 100 g/sm^2 , 2 -300 g/sm^2)

In fig.2 one can see the strongly marked minimum of 5-year variation amplitude in 1974-1976. For seasonal variations the decrease of amplitude in SA minimums of 1965, 1977 is interesting. Seasonal variation amplitude is within the limits of 3%, 5-year variations amplitude is not more than 11%. Maximal values of amplitudes are observed in the periods of SA maximums.

Variations energy spectra were calculated by use of Earth atmosphere as an energy spectrometer [3]. In fig.3 results of seasonal and 5-year variations energy spectra power index calculations by stratosphere data are presented.

Spectrum becomes more rigid in periods of SA minimums, particularly rigid spectrum takes place in 1974 for 5-year variations (γ>0) and in 1966-1967 for seasonal variation. We consider that more rigid spectrum in SA minimums is formed by more high contribution drift effects to GCR modulation in this periods [4]. It is interesting that seasonal and 5-year variations energy spectra change in anti-phase during 1960-1970.



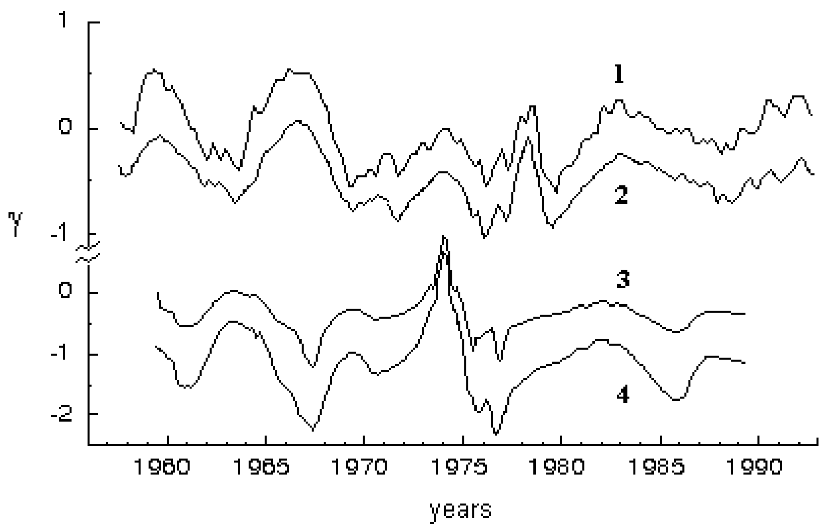


Fig. **3** Change of variations energy spectra power index in time: 1,2—seasonal and 3,4—5-year (1,3 - 100 g/sm^2, 2,4 - 300 g/sm^2)

Fig.4 illustrate seasonal and 5-year variations N-S asymmetry, that was obtained on basis of data of CR stratosphere registration in Murmansk and Mirny.

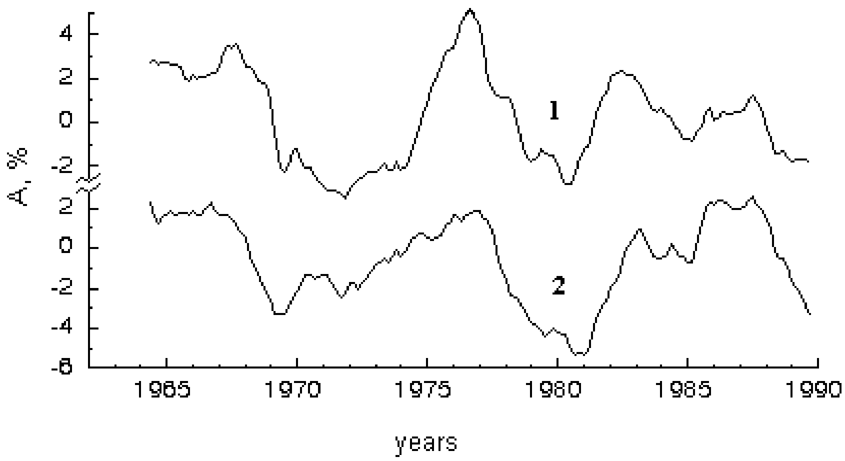


Fig.**4a**. N-S – asymmetry of seasonal variations (1 - 50 g/sm^2 , 2 - 200 g/sm^2)

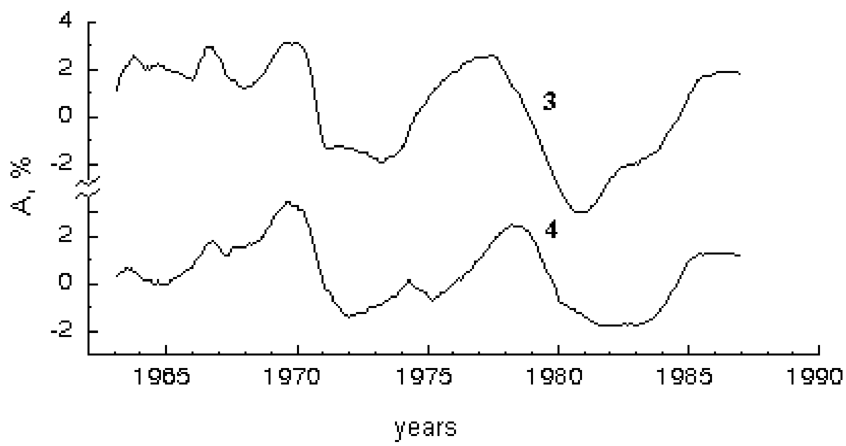


Fig.**4b**. N-S – asymmetry of 5-year variations (1 - 50 g/sm^2 , 2 - 200 g/sm^2)

From fig.4a one can see that maximums of seasonal variations N-S asymmetry in SA minimums and strongly marked minimums of N-S asymmetry in SA maximums take place and besides this effect observes both for low energy region (50 g/sm ^{2}) and for higher energy reigion (200 g/sm^2). Fig.4b shows maximums of 5-year variations N-S asymmetry near SA maximums. This effect can be explained by Gnevishev gap in cosmic ray physics [5,6].

References:

1. Kolomeets E.V., Shvartsman Ya.E.et al. Preprint No 3, izd. KazGU, Almaty, 1972.

2. Dolginov A.Z. et al. Proceedings of X International Cosmophysics Seminar, Leningrad, 1978, p.345.

3. Kolomeets E.V., Krupennikov O.V. Izv. AN RAN, ser. fys, v. 57 , No 3, p. 111 - 119, 1993.

4. Kolomeets E.V., Stekolnikov M.I., Shvartsman Ya.E. Proc. XII ICRC, Denver, 2, p.1207, 1973.

5. Bazilevskaya G.A. et. al. Proc. 16th ECRC, p.83-86, 1998.

6. Gnevishev M.N. Solar Phys. p.175 - 183, 1977 .